Groundwater contamination in the Heathcote/Woolston area, Christchurch, New Zealand

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Abstract

Christchurch City (population 360,000) depends entirely on an underlying stratified, leaky, confined, artesian aquifer system to provide untreated water for its residents and industries.

Concerns have been raised by the Canterbury Regional Council about brackish water entering the aquifer system in a localised area in the south-eastern part of the City (Woolston/Heathcote). Due to the coastal, urban, and geological, setting of the area several possible groundwater contaminant sources exist and needed to be investigated. These include: seawater, urban wastes, thermal groundwater, and connate seawater.

A potentiometric survey carried out in the area, combined with water quality sampling, hydrogeological information from previous studies, and previously obtained water quality data, provided the basis for a conceptual model of groundwater contamination. Downward leakage of estuarine water through the confining layer appears to be the dominant contaminant source.

In the past, the potential risk of seawater intrusion has been regarded as low for the Christchurch artesian aquifer system. The freshwater/seawater interface was considered to be located 40km offshore where the uppermost confined aquifer intersects with the sea at its submarine outcrop. To enhance the understanding of freshwater and saltwater flow dynamics of the aquifer system, a steady-state cross-sectional finite-difference model along the coast of Christchurch has been constructed and calibrated. The modelling indicated that the location of the freshwater/seawater interface is dominated by leakage from the sea through the confining layer and not, as presumed before, by lateral inflow of seawater through the offshore outcrop. Consequently the interface location is to be expected much closer to the shoreline at approximately 3km offshore.

Groundwater contamination in a localised area in Christchurch has demonstrated that the uppermost confining layer does not act as an effective barrier towards seawater intrusion where the hydraulic gradient between the sea and the aquifer is directed downward.

A groundwater level and quality monitoring network, and a groundwater model specific to the study area, have been constructed to facilitate the future management of the resource. Immediate pumping restrictions are needed on 3 major abstraction wells to increase potentiometric heads that currently sit below sea level. An upward hydraulic gradient between the uppermost aquifer, the estuary, and the confining layer, is essential to protect the aquifer from ongoing downward leakage of saline contaminant sources. Ongoing monitoring of water levels and groundwater quality is recommended. This data will allow more refined modelling of management scenarios.

Zusammenfassung

Die Wasserversorgung der Stadt Christchurch (360,000 Einwohner) in Neuseeland wird durch das unterliegende, geschichtete, artesische System von Aquiferen sichergestellt.

Seit einigen Jahren wurde eine zunehmende Salinität des Grundwassers in einer Gegend im Südosten der Stadt (Woolston/Heathcote) festgestellt. Dies regte den Canterbury Regional Council dazu an, eine Studie zu initiieren, um den Grund für die verschlechterte Grundwasserqualität zu erschließen. Wegen der Küstennähe, der städtischen Umgebung und den geologischen Gegebenheiten kamen mehrere Grundwasserkontaminanten in Frage. Diese umfassen: Meerwasser, Mülldeponien, Thermalwässer und konnates Wasser.

Vorhandene hydrogeologische Informationen, die Chemie des kontaminierten Grundwassers und gemessende Wasserstände unterhalb des Meeresspiegels in Relation zur verschlechterten Grundwasserqualität deuteten darauf hin, daß Meerwasser aus dem nahe gelegenen Ästuarin durch die grundwasserhemmende Schicht in das oberste Aquifer sickert.

Bisher wurde das Risiko der Grundwasserverschmutzung durch Meerwasserintrusion in den Christchurch Aquiferen als gering angesehen. Es wurde angenommen, daß die Übergangszone zwischen Süß-und Meerwasser 40km von der Küste enfernt liegt, wo das oberste Aquifer aufgeschlossen ist. Mit Hilfe eines Computermodelles, welches angewendet wurde, um die Christchurch Aquifere zu simulieren, zeigte sich jedoch, daß die Lage der Übergangszone zwischen Süß-und Meerwasser nicht nur das Eindringen von Meerwasser durch den submarinen Aufschluß des Aquifers bestimmt wird, sondern vielmehr durch das beständige Sickern von Meerwasser durch die oberste grundwasserhemmende Schicht. Folglich ist die Übergangszone zwischen Süß-und Meerwasser viel näher an der Küste zu erwarten, ungefähr 3km von der Küstenlinie entfernt.

Grundwasserkontamination in einem noch sehr begrenzten Teil der Stadt deutet darauf hin, daß die oberste grundwasserhemmende Schicht keine wirkungsvolle Barriere gegen Meerwasserintrusion ist, wenn der hydraulische Gradient nach unten gerichtet ist.

Ein Überwachungssystem für Wasserqualität und Wasserstände und ein Computermodell, welches die spezifischen hydrogeologischen Gegebenheiten des Arbeitsgebietes simuliert, wurden erstellt, um das zukünftige Management der Aquifere zu erleichtern. Sofortige Beschränkungen der Grundwasserentnahme von 3 Brunnen sind nötig, um die Wasserstände, die sich derzeit unterhalb des Meeresspiegels befinden, wieder zu steigern. Ein nach oben gerichteter hydraulischer Gradient zwischen dem obersten Aquifer, dem Ästuarin und der obersten grundwasserhemmenden Schicht ist notwendig, um eine weitere Gefährdung der Grundwasserqualität zu vermeiden. Eine weitere Überwachung der Wasserstände und der Wasserqualität wird empfohlen. Die somit gesammelten Daten sollten zu einer verbesserten Computersimulation von Management Strategien genutzt werden.

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1 Introduction

1.1 Project Background

Coastal aquifer systems are especially vulnerable to groundwater contamination by seawater intrusion. As a consequence of high rates of groundwater abstraction hydraulic heads may decrease, drawing the freshwater/seawater interface inland, and/or upconing of underlying saltwater into abstraction wells may occur. In the past, the multilayered Christchurch artesian aquifer system has been regarded as less prone to the threat of seawater intrusion than other coastal aquifers because of its confinement, extending to about 40km offshore, and the presence of an upward directed hydraulic gradient. However, over the past 20 to 30 years an increasing salinity has been reported from a number of wells, mainly those abstracting groundwater from the uppermost aquifer (Riccarton Aquifer) within the Woolston/Heathcote area, adjacent to the estuary. WILSON (1973) reported that the Heathcote area had the lowest potentiometric pressures within Christchurch, suggesting that this area may be the most susceptible to seawater intrusion. Seawater intrusion is a threat to the quality of the groundwater on which Christchurch City (population ca. 360,000) currently relies to provide 100% of its reticulated drinking water supply. However, a number of other potential saline water sources exist and were investigated in this study: connate seawater leaching from the Christchurch Formation and/or Bromley Formation, connate seawater derived from a sea stack close to the study area, thermal waters related to Banks Peninsula volcanism, and anthropogenic sources.

1.2 Physical Setting

The study area comprises the south-eastern part of the city of Christchurch, South Island, New Zealand. It is located along the northern margin of Banks Peninsula, an extinct volcanic complex to the south of the city, and adjacent to the Estuary of the Heathcote and Avon Rivers (Figure 1.1).

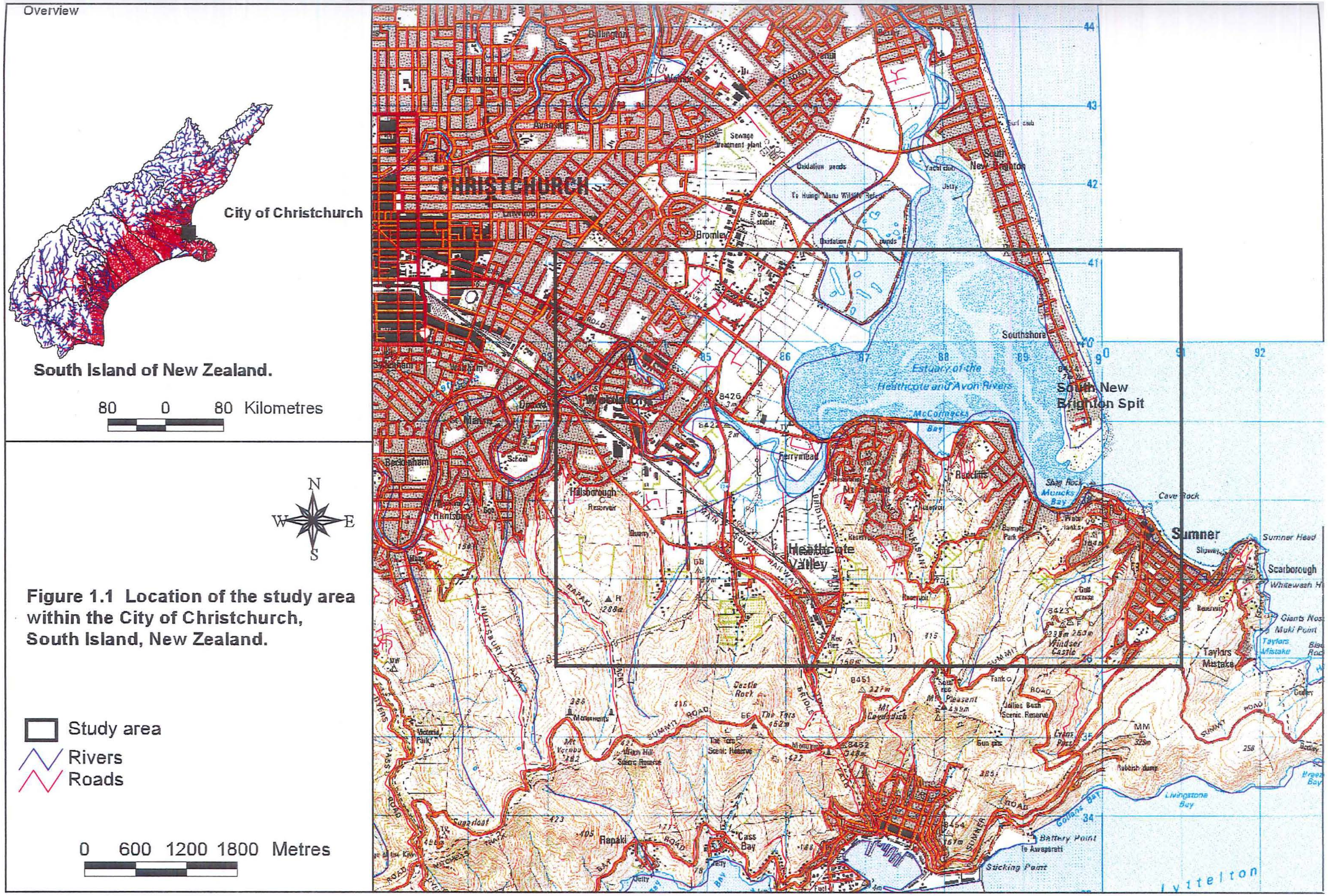


Figure 1.1 Location of the study area within the City of Christchurch, South Island, New Zealand.

1.3 Historical Background

With about 360,000 inhabitants, Christchurch is the largest city of the South Island of New Zealand. It was established in the 1850s after the arrival of the first European settlers. The area was described as swampland at that time. The water supply was mainly obtained from the Avon River, which flows through the city centre toward the estuary, and from ponds. Since the city's surface waters quickly became polluted from urban wastes, other water sources were needed. In 1862 W. Gee, a confectioner and manufacturer of aerated waters, claimed to have sunk an artesian well which provided *"an inexhaustible supply of the purest water"* (BROWN AND WEEBER, 1992). Meanwhile approximately 7,000 wells have been sunk within the urban area of Christchurch (CRC, 1997a). Long-term water level monitoring wells indicate that groundwater abstraction over the past 130 years has resulted in a general decline of artesian water levels. However, equilibrium between recharge and discharge seems to have been established for about the past 60 years. Adverse effects of the water level decline have not been detected except for possibly within the Woolston/Heathcote Valley area (TALBOT *et al.*, 1986).

1.4 Previous Work

WILSON (1973) reported low potentiometric pressures for each of the four aquifers beneath the Christchurch Estuary. He indicated that, although there was no immediate risk, this might have future implications for seawater intrusion from the east. He suggested that groundwater management should take the risks of seawater intrusion, decline of artesian water levels, and differential subsidence into account and investigate artificial recharge of the coastal aquifers.

Indications for groundwater pollution in the Woolston/Heathcote area are given in TALBOT *et al.* (1986). It was suggested that the degrading groundwater quality might be caused by localised seawater intrusion. In general the risk of seawater intrusion was regarded as unlikely for the Christchurch artesian aquifer system. A conceptual physical model of the Christchurch groundwater system was developed indicating the location of the freshwater/seawater interface for the top confined aquifer at 40km offshore. It was suggested that although groundwater abstractions might have led to a landward shifting of the freshwater/seawater interface it still remains far offshore.

WEEBER (1993) compiled an unpublished report on the groundwater resources of the Woolston/Heathcote Valley area. A buried volcanic ridge/sea stack complex extending northwards from the Port Hills into Woolston, limiting groundwater recharge to the area, was identified. Furthermore, it was suggested that the reduced thickness of the uppermost aquifer and the absence of deeper gravel aquifers in the area might put limits on groundwater abstraction. Four possible scenarios for groundwater contamination were suggested:

1. Seawater intrusion.
2. Connate seawater leaching from the overlying or underlying formations into the aquifer from which groundwater is abstracted.
3. Mixing of thermal and/or mineralised groundwater discharging directly from the buried Woolston volcanic ridge/ sea stack complex.
4. A combination of 1 and 3.

BROWN and WEEBER (1994) further investigated the problems of the Woolston/Heathcote area. Based on geochemical mixing trends it was suggested that some seawater intrusion and mixing of groundwater derived from the underlying volcanic rock is responsible for the salinity of the Heathcote Valley area.

The geology and hydrogeology of Christchurch is described by several authors including OBORN, (1956), WILSON (1973, 1976), BROWN *et al.* (1988), BROWN and WEEBER (1992), and BROWN *et al.* (1995). A very detailed report which describes the nature of the artesian aquifers beneath Christchurch and attempts to quantify the safe yield of the aquifers was compiled by TALBOT *et al.* (1986). The Christchurch-West Melton Groundwater Report (1-3) (CRC, 1997) represents a synthesis of data relevant to the assessment of restrictions to groundwater abstraction for the Christchurch groundwater resource.

1.5 Objectives

The research objective was to determine the likely source(s) of observed groundwater quality anomalies within the Woolston/Heathcote area Christchurch. This involved a review of previous hydrogeological information and hydrochemical data of the aquifer system and the filling of data gaps. The main objective was to determine whether seawater intrusion caused the brackish water which has been observed in several wells within the study area. Other objectives were:

1. Potentiometric surveys of aquifers in the study area.
2. A review of all relevant hydrogeological and hydrochemical information on the area, and integration and synthesis with the new data.
3. The design and execution of an appropriate monitoring programme for hydrochemistry and water levels. This included the location of wells, groundwater sampling, and conceptual modelling to assist the design of the programme.
4. To determine future management strategies for the Woolston/Heathcote aquifers to help minimise the adverse environmental effects from abstraction and groundwater contaminant sources.

1.6 Project Support

The Christchurch City Council, the Canterbury Regional Council and the Mason Trust Fund provided funding for the investigation including analytical costs and monitoring well installation. Logistical support including transport facilities, field equipment, and computer facilities were provided by the Canterbury Regional Council. Groundwater sampling, potentiometric surveying and the design and organisation of the monitoring well network was undertaken by the author with assistance from Canterbury Regional Council staff. Historical data on water quality and well logs were obtained from the database of the Canterbury Regional Council. Technical advice and assistance of the Canterbury Regional staff is gratefully acknowledged.

2 Geographical and geological framework

2.1 Geomorphology

The Canterbury Plains are located on the East Coast of the South Island. They extend 160km from Timaru in the south to the Waipara River in the north, are approximately 50km wide and cover an area of 8000km^2 (see Figure 2.1). The western margin of the plains is at an elevation of approximately 350m above mean sea level. The plains are generally flat to slightly undulated and slope about 6m per kilometre on average toward the Pacific Ocean. Degradational terraces along major rivers represent stages of down cutting.

Banks Peninsula to the south of Christchurch City is an elliptical shaped volcanic complex, about 35km in diameter with two main craters at Lyttelton Harbour and Akaroa Harbour. The highest peak on Banks Peninsula is Mt. Herbert at 920m altitude.

2.2 Climate

The Canterbury Plains are dominated by a sub-humid climate with a mean annual rainfall of 650mm, ranging from about 1400mm in the foothills to 600-700mm at the coast. Mean annual rainfall within the study area ranges from 600-700mm. The mean temperature ranges around 16.5°C in summer and 5-6°C in winter. The climate is dominated by the winds. North-west föhn winds dominate during the summer season from October to January and bring warm and dry air into the area. More rain precipitates during the winter months June, July and August. Rain and cold air is related to south and south-west or to east and north-east winds.

The climate on Banks Peninsula is quite distinct from the coastal Canterbury Region with rain of up to 2000mm on its south-eastern peaks.

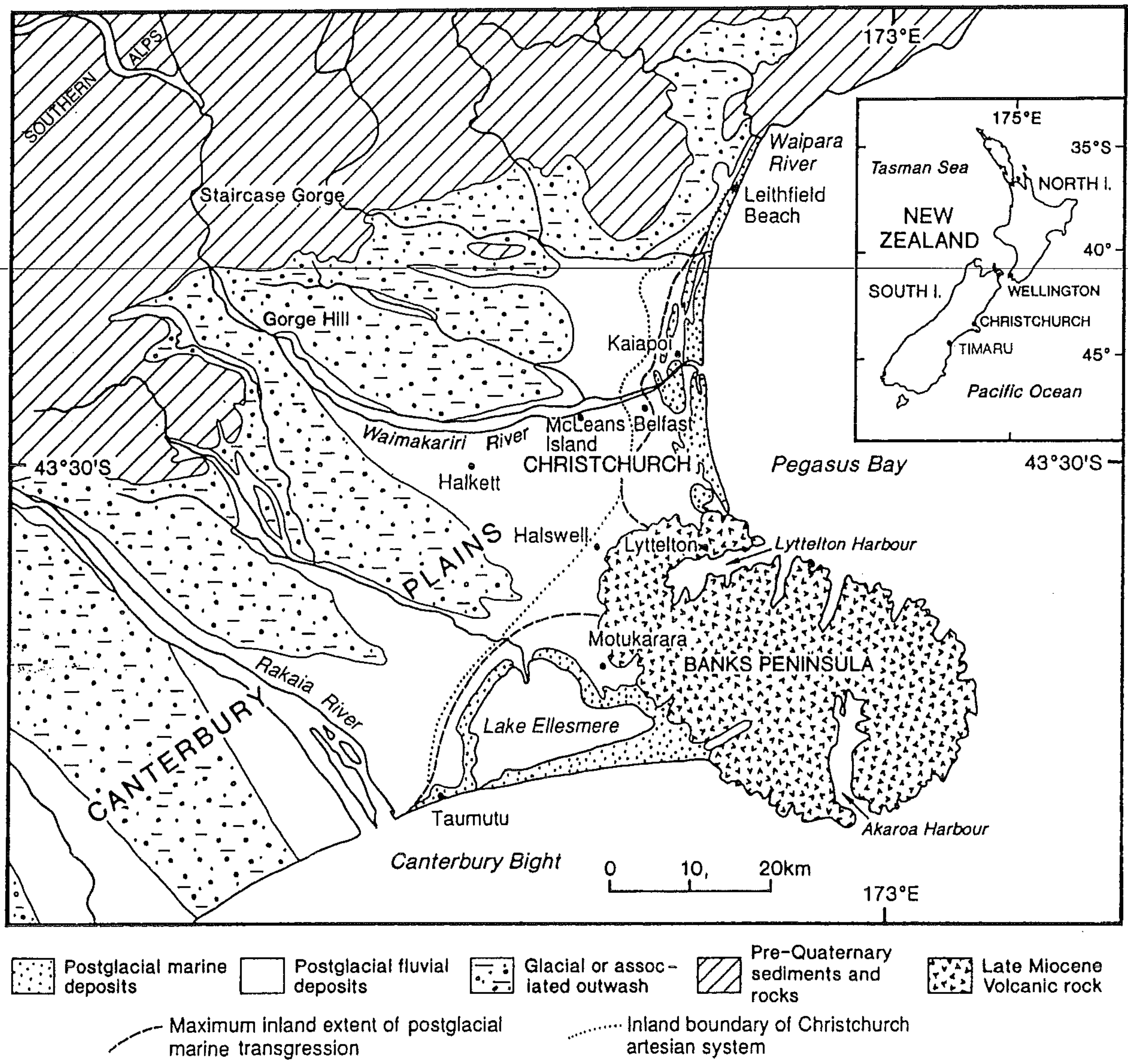


Figure 2.1 Northern Canterbury Plains general geology with inset of New Zealand for location (from BROWN *et al.*, 1995).

2.3 Landuse

Agriculture, predominantly pastural sheep and cattle farming, dominates landuse on the Canterbury Plains. Cropping and horticulture, including market gardening, become more common where sufficient water is available around population centres such as Christchurch City. Only small areas are used for forestry. Most of the land in Christchurch City is taken by residential properties. Industries are mainly located in the central and western part of the city and in the suburbs of Woolston and Heathcote.

The Woolston/Heathcote area is mainly an industrial site with fish processing industries, a tannery, gelatine production, etc. Pockets of low-lying poorly drained pastureland used for horses and cattle are found close to the estuary. The main recreational sites are the estuary, the beach, a historic park near the estuary, and a park near the Port Hills. The residential area is mainly spread along the Port Hills.

2.4 Soils

Soils of the Christchurch area are shown in Figure 2.2. Most of the soils to the west of Christchurch are stony, so are free draining and have insignificant surface runoff. The soils of Christchurch City are less freely draining which, prior to artificially lowering of the water-table, led to flooding (TALBOT *et al.*, 1986). Four groups of soil types can be recognised in the Canterbury Region (TALBOT *et al.*, 1986):

1. **Waimakariri Fan Soils**: dominant to the west of the city. These evolved from stony greywacke alluvium and have a thin veneer of loess in some places. These soils are generally free draining.
2. **Lowland and Drained Swamp Land Soils**: dominant in Christchurch City. They were formed from fine sediments and are poorly drained. They experienced periodic or permanent high water-tables prior to artificial drainage and may still be flooded after intensive rainfall events.
3. **Sand Dune Soils**: extend along the coastal area of the Canterbury region. These evolved from dune sand and are well drained.
4. **Port Hills Soils**: dominant on Banks Peninsula. They are derived from the volcanic rock (basalt) of Banks Peninsula and a loess mantle. These soils are generally not well drained.

Soils in the study area consist of the Motukarara silt loam, which belongs to the poorly draining Lowland and Drained Swamp Land Soils. Intensive flooding in the area led to the construction of the Woolston cut in 1986, where a winding section of the lower Heathcote river was straightened and flood control works were installed (WILSON, 1989). After the project was completed, residents complained about trees dying along the river, which was caused by an increase in salinity of the river water.

LEGEND

Soils of the Port Hills

- 15f Takahe soils
- 15gH Kiwi hill soils
- 54H Summit hill soils
- 77 Evans steepland soils
- 77a Stewart steepland soils

Soils of the Waimakariri fan

- W or 9- Waimakariri soils
- Waimakariri stony soils

- S or 10- Selwyn soils
- Selwyn stony soils

Soils of the lowland and drained swamp land

- 13- Kaiapoi soils
- 14- Taitapu soils
- 15- Horotane soils
- 16- Waimairi soils
- 17- Te Kakahi soils
- 18- Aranui soils
- 19- Motukarara soils

Soils of the coastal sand dunes

- 20- Kairaki soils
- 21- Waikuku soils

Soils within the urban area

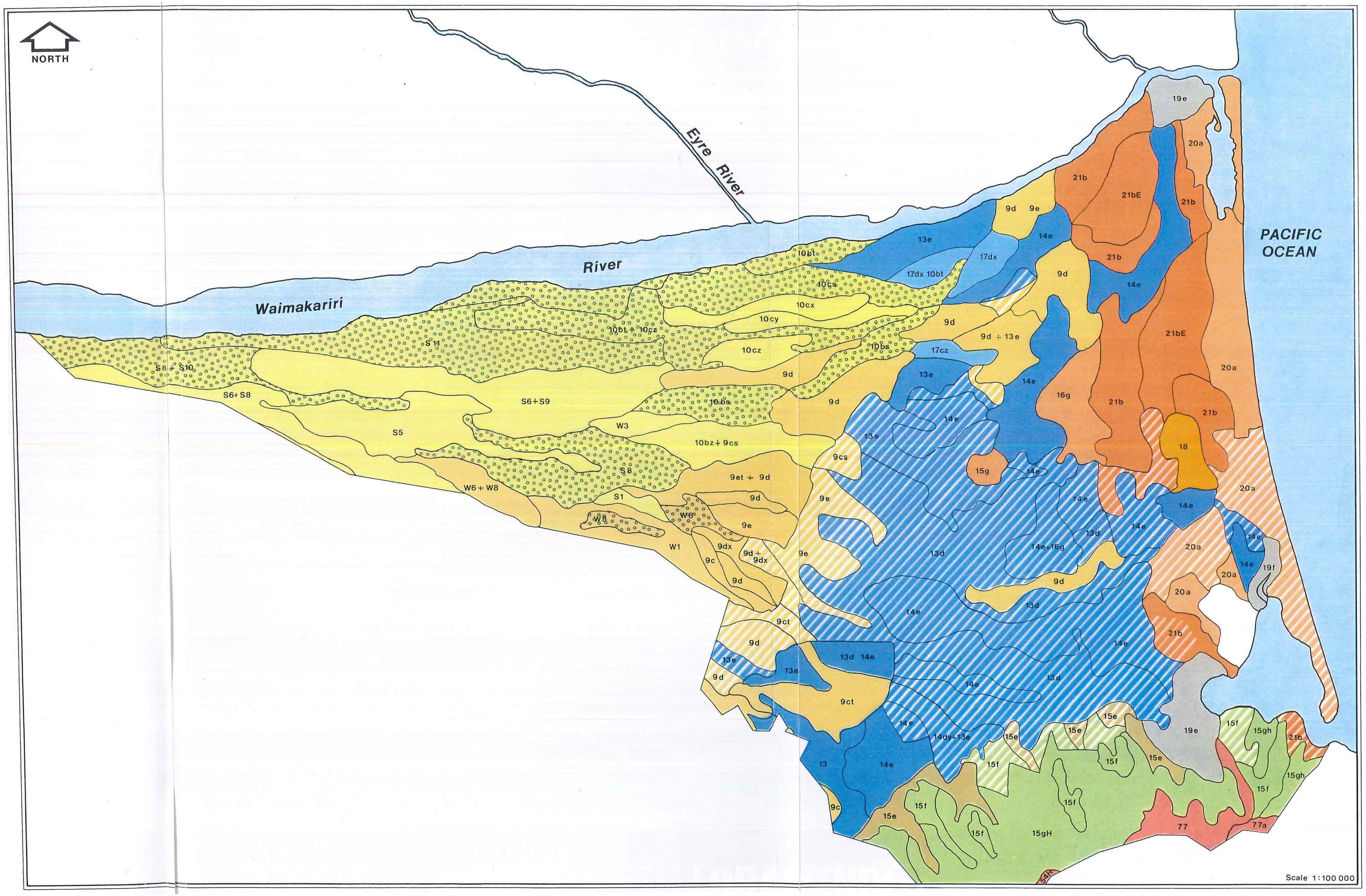


Figure 2.2 Soils of the Christchurch area (taken from TALBOT *et al.*, 1986; source : Soil Bureau Bulletins 24, 34 and Report 16).

2.5 Regional Geology

The basement in the Canterbury region is made up of extensively folded and faulted Torlesse Supergroup rocks (sandstones (greywackes), argillites, and minor volcanics). These represent an accretionary wedge complex of Permian to Late Triassic age. This basement is unconformably overlain by slightly folded, Late Cretaceous and Tertiary coal measure sediments, comprising sands, marls, limestones, sandy limestones and minor conglomerates. The Canterbury Plains derive from the erosion of the Southern Alps, a fault-related south-west to north-east striking mountain range across the South Island. The Southern Alps have experienced high uplift rates during the Kaikoura Orogeny during the last few million years. Eastward flowing rivers deposited a large complex of coalescing alluvial gravel and sand fans. The Quaternary sequence consists of interfingering coarse alluvial gravel and fine marine and alluvial silt, clay, and sand strata, dipping at shallow angles to the east. Figure 2.3 illustrates a simplified cross-section, through the Canterbury region. Petroleum exploration bores indicate that the Quaternary sequence varies in vertical thickness and can reach more than 500m (BROWN and WEEBER, 1992).

2.6 Stratigraphy of the Quaternary deposits beneath Christchurch

Figure 2.4 shows a perspective cross-section of the Canterbury Plains and illustrates the stratigraphy of the Quaternary units. Coarse alluvial gravel strata are interbedded with fine marine and alluvial layers of silt, clay, peat, and shelly sand and clay. The coarse gravel strata were deposited by rivers during glacial periods and form the aquifers known by unit names including the term "Gravel" (e.g., Riccarton Gravel, Burwood Gravel). The fine marine layers derive from the transgression of the sea during interglacial periods. The term "Formation" (e.g., Christchurch Formation, Heathcote Formation) indicates the fine marine and alluvial deposits which act as aquitards. The lithological descriptions shown in Table 2.1 are summarised from CRC (1997a), BROWN and WEEBER (1992) and BROWN *et al.* (1988).

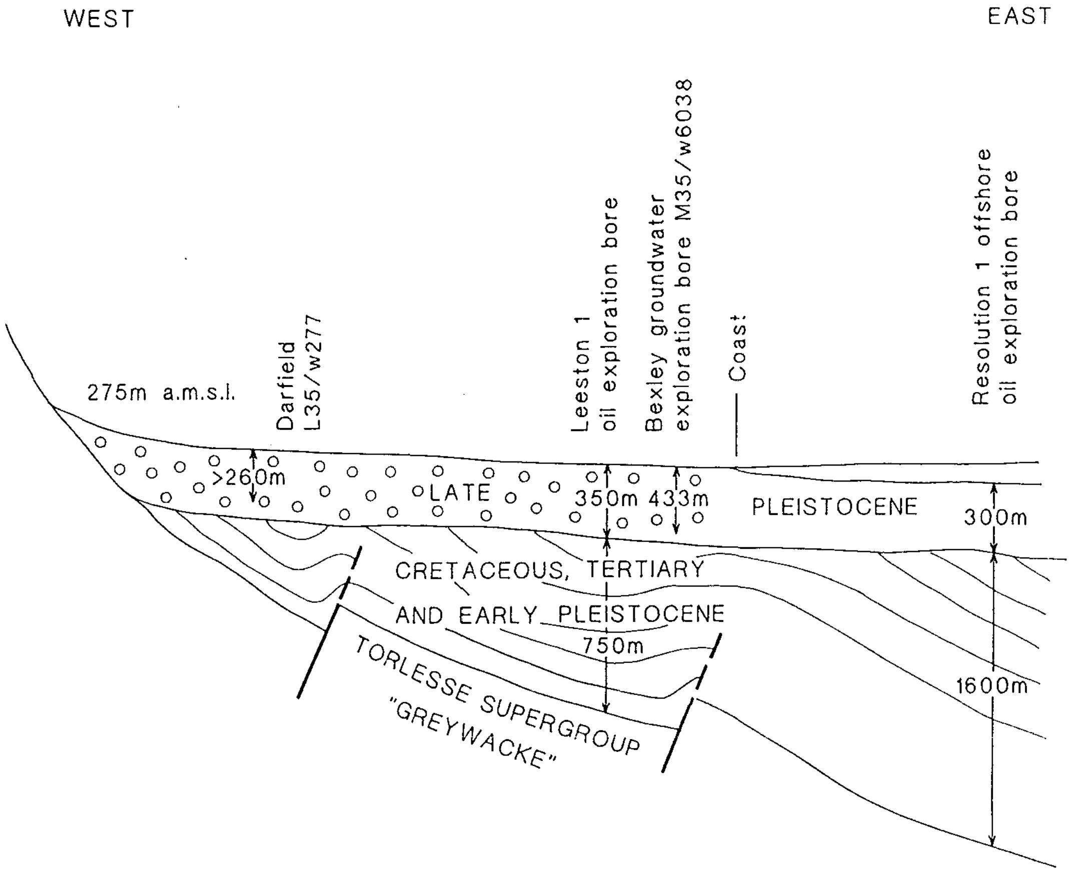


Figure 2.3 Diagrammatic cross-section through the northern Canterbury Plains (from BROWN and WEEBER, 1992).

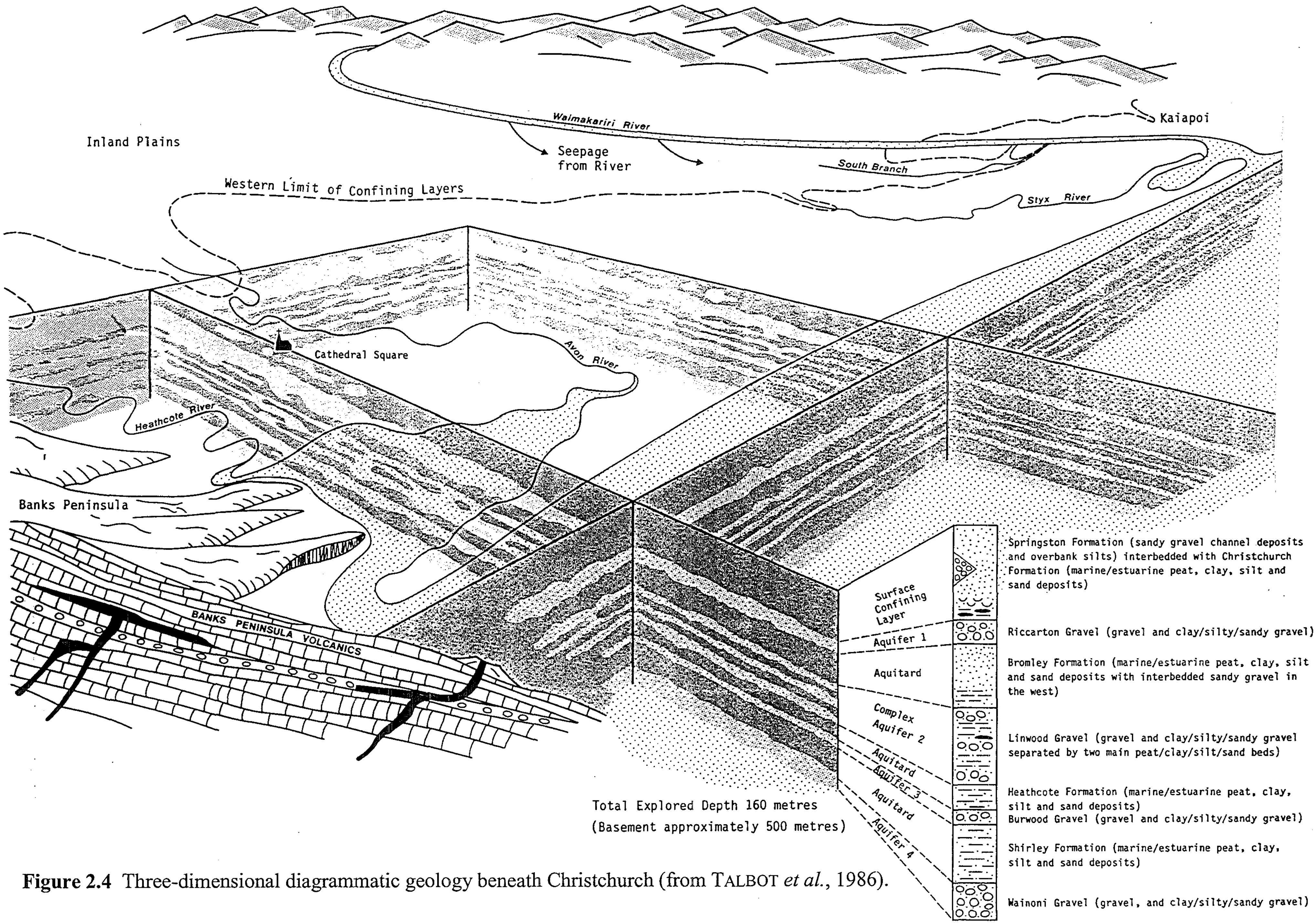


Figure 2.4 Three-dimensional diagrammatic geology beneath Christchurch (from TALBOT *et al.*, 1986).

Geological unit	Description
Christchurch Formation (top section)	Predominantly blue gravel, sand, shelly sand and silt, clay, peat, and wood. It reaches its maximum thickness of 40m from ground surface at the coast and is thinning to 5m in the City Centre. It comprises beach, estuarine, lagoonal, dune, and coastal swamp sediments deposited at the end of and after the Otira glaciation about 1400 years ago.
Springston Formation (top section)	Well-sorted rounded gravel with dominantly sand matrix containing lenses of silt and clay of up to 20m thickness in the west of Christchurch. The formation represents postglacial fluviatile deposition at the inland extent of the Christchurch Formation.
Riccarton Gravel	Blue and brown gravel with some sand and silt layers and rare peat deposits. The maximum thickness is 30m beneath Christchurch. It represents fluviatile glacial outwash.
Bromley Formation	Blue-grey gravel, sand, silt, clay, shelly clay, and peat, containing some brown gravel, and brown and yellow clay layers and interbedded gravel-filled channels. It occurs about 30-60m below ground surface and its thickness ranges from a few meters to its maximum thickness of 30m in the Heathcote Valley. It represents coastal swamp, beach, lagoonal and dune sediments, which were deposited during interglacial periods.
Linwood Gravel	Brown gravel with matrix of brown sand and clay with blue clay and sand layers and occasional peat layers with a depth of about 60-100m below ground surface and a maximum thickness of 40m. It is thinnest beneath the areas in the south of Christchurch adjacent to Banks Peninsula. The gravel represents glacial-outwash derived river deposits.
Heathcote Formation	Blue/grey gravel, sand silt, clay, shelly clay, and peat, interbedded with some brown gravel and brown and yellow clay layers with its top at about 70m and the bottom at about 100m. Maximum thickness is circa 30m. The Formation comprises estuarine and marine sediments, which grade laterally westwards into swamp deposits.
Burwood Gravel	Brown gravel with matrix of brown sand and yellow and brown clay and silt, containing yellow clay layers lies between 100-120m below ground surface and is up to about 20m thick. Outwash rivers deposited the gravel during glacial periods.
Shirley Formation	Blue, brown and yellow gravel, sand, silt, and clay with interbedded peat and wood, and shelly layers occurs at a depth of about 120-150m below the ground surface. The thickness can reach up to 30m. The formation represents beach, lagoonal, dune and coastal swamp deposits associated with sea level fluctuations.
Wainoni Gravel	Brown gravel occurs between 150-170m depth below the ground surface at New Brighton coast with a maximum thickness of 20m. It is described from lithological logs as having a matrix of brown sand and yellow and brown clay and silt, containing few layers of blue gravel, yellow clay and brown clay, sand, and silt. The gravel unit represents glacial outwash-derived river deposits.
Deeper un-named strata (bottom section)	Brown and blue clay, silt, sand, and peat underlain by a gravel have been penetrated by deeper wells. The gravel strata do not yield enough water for drinking-water supply due to their high content of clay, silt, and sand matrix.

Table 2.1 Lithological description of the geological units beneath Christchurch.

3 Hydrogeology

3.1 The Nature of the Christchurch Artesian Aquifer System

The inland boundary of the Christchurch artesian aquifer system is shown in Figure 2.1. Water bearing Quaternary gravel strata (aquifers), separated by fine sand, silt, peat, and clay layers (aquitards) form the multilayered, confined Christchurch artesian aquifer system. Figure 3.1 shows the sequence underneath Christchurch. The uppermost aquifer is the Riccarton Aquifer, also called Aquifer 1. It is the main groundwater bearing strata for Christchurch City water supply (CRC, 1997a). Below the Riccarton Aquifer occur the Linwood (Aquifer 2), Burwood (Aquifer 3), and Wainoni (Aquifer 4) aquifers, each of them separated by confining layers. The uppermost confining layer thickens towards the sea and is thought to act as a vertical low permeable barrier against surface contaminant sources such as urban wastes.

Figure 3.2 summarises the most important characteristics of the Christchurch aquifer system. Water is mainly recharged from the Waimakariri River. Other sources of recharge are rainfall on the inland plains and upward leakage from underlying aquifers. Since the artesian pressures in the aquifers increase with depth, hydraulic heads of deeper aquifers are higher than those of shallower aquifers. Consequently groundwater follows the upward directed hydraulic gradient leaking through the confining layers to the overlying aquifers. As shown in Figure 3.2, the uppermost confining layer pinches out to the west and the aquifer system becomes unconfined. Aquifer 1 is thought to outcrop about 40 km offshore. The freshwater/seawater interface within Aquifer 1 is indicated as a dotted line in Figure 3.2, however, its position is only assumed. The lower aquifers are believed to wedge out towards the east and to contain freshwater only. Based on this belief the Christchurch aquifer system has been regarded as less prone to seawater intrusion than most other coastal aquifers (BROWN *et al.,* 1995).

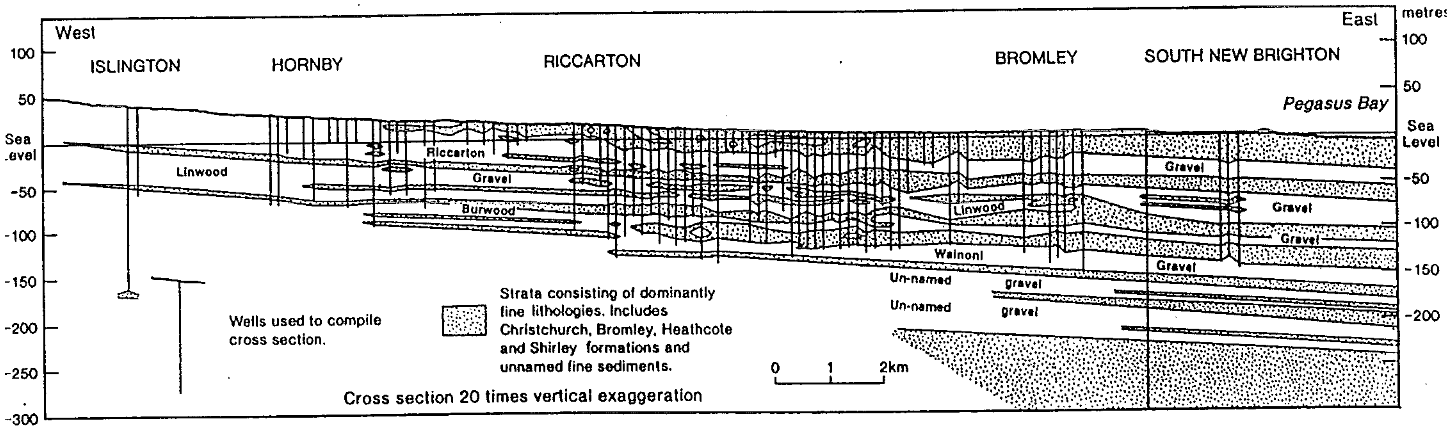


Figure 3.1 Stratigraphy of the Christchurch-West Melton Area (from BROWN and WEEBER, 1992).

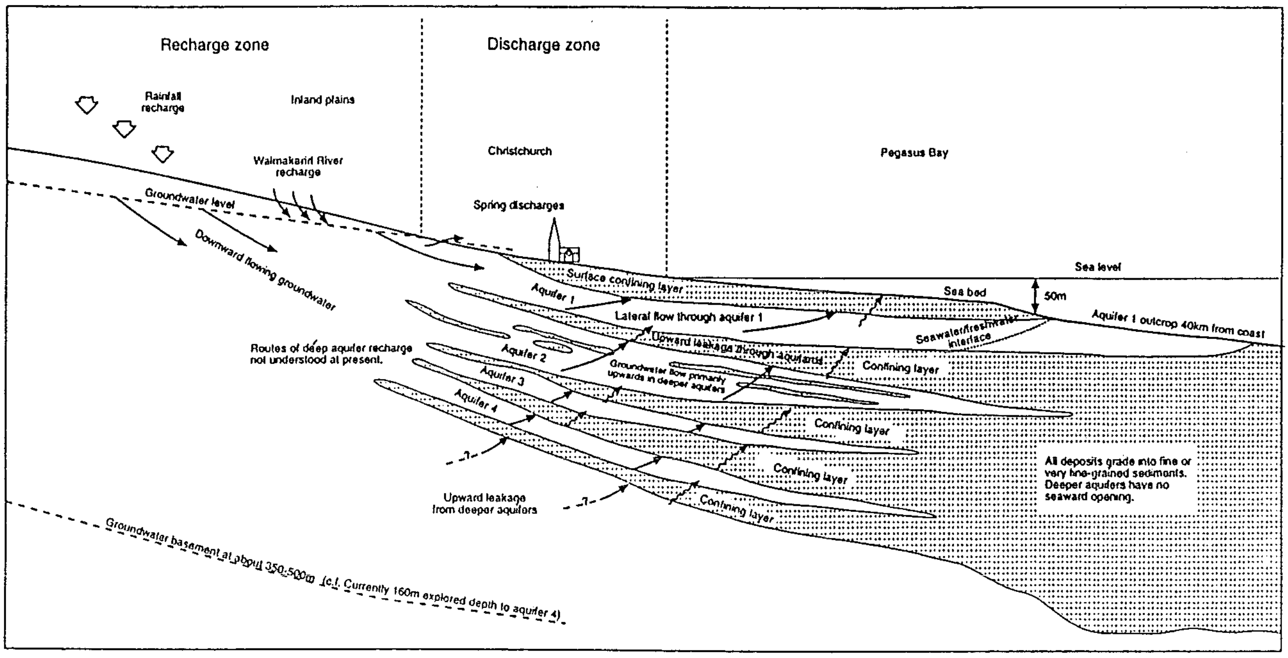


Figure 3.2 Conceptual diagram of the Christchurch aquifer system (from TALBOT *et al.*, 1986).

3.2 Hydraulic behaviour of the Christchurch Artesian Aquifers

Figure 3.3 shows a potentiometric contour map of Aquifer 1 for the Canterbury region from a 1985 survey (TALBOT *et al.*, 1986). The contour lines are approximately NE-SW orientated and decrease in elevation towards the east. Groundwater flow is directed perpendicular to the contour lines towards the south-east. Close to Banks Peninsula, groundwater flow is diverted to the north and south around the relatively impermeable volcanic rocks of Banks Peninsula. Unfortunately no detailed potentiometric contour map for Christchurch City is available. A potentiometric cross-section and hydraulic gradients of the artesian aquifers are shown in Figure 3.4 (TALBOT *et al.*, 1986). The hydraulic gradient decreases towards the coast. The potentiometric levels of the aquifer increase with the depth of the aquifers; they are still above sea level along the coast.

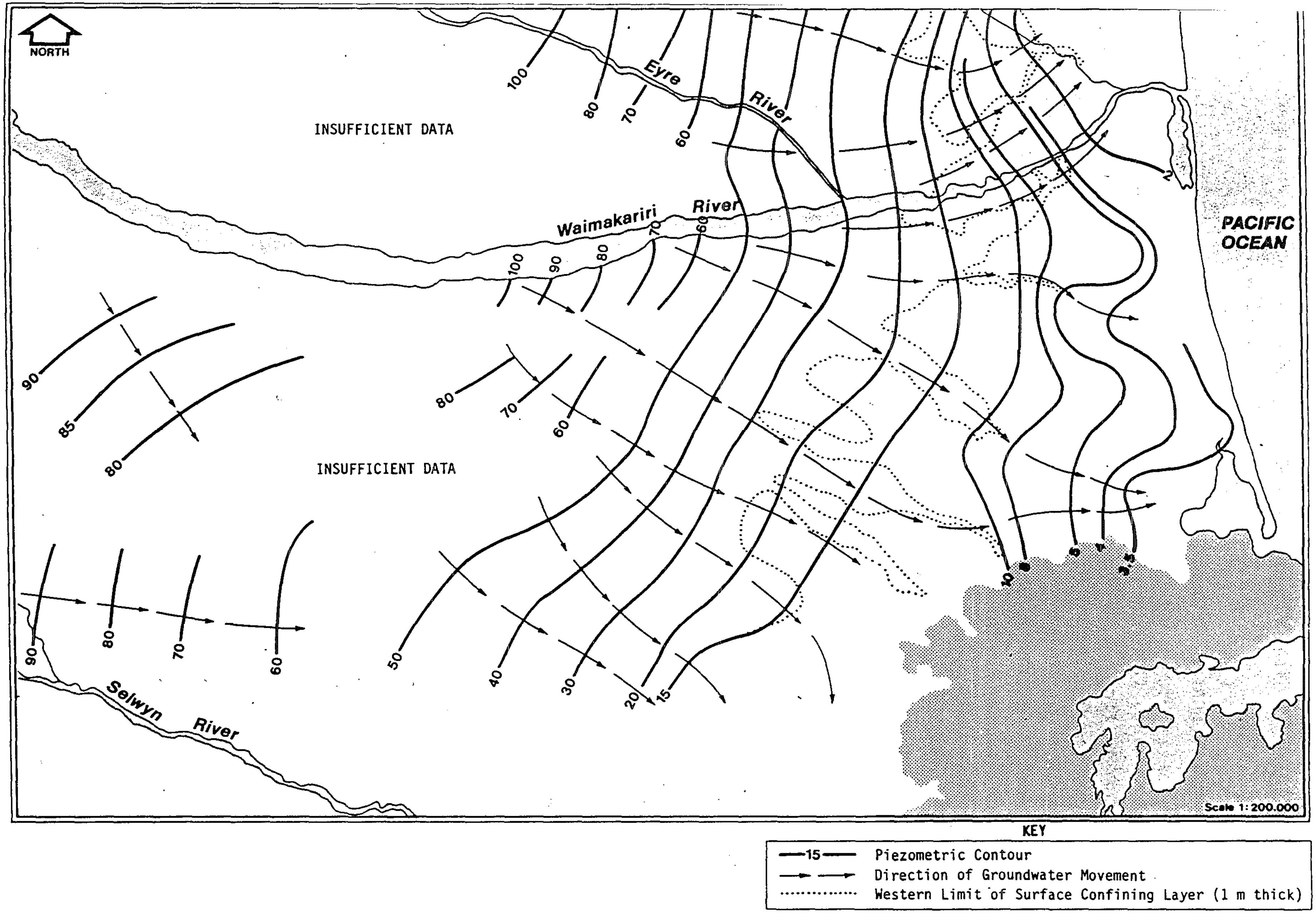


Figure 3.3 Contours of the Aquifer 1 potentiometric surface in metres above mean sea level and direction of groundwater flow (May 1985) (from TALBOT *et al.*, 1986).

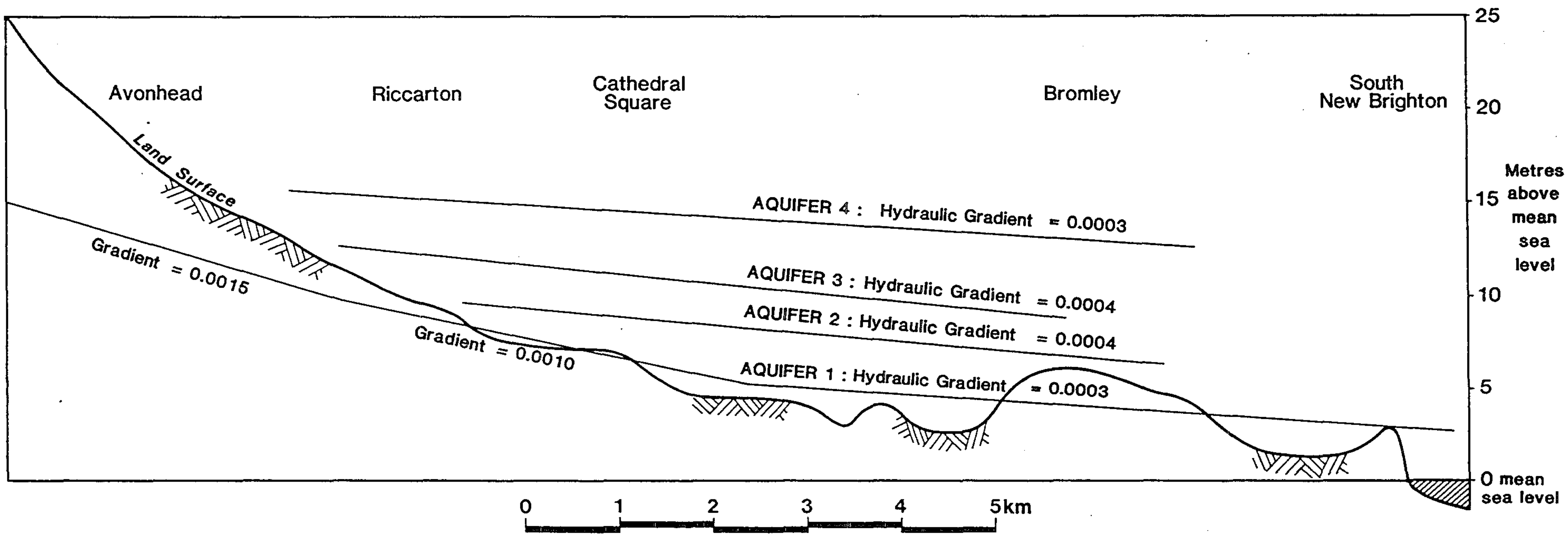


Figure 3.4 Potentiometric cross-section comparing levels and hydraulic gradients of artesian aquifers (from TALBOT *et al.*, 1986).

3.3 Aquifer and aquitard thicknesses and parameters

Figure 3.5 to 3.6 (taken from DAVE SCOTT, *pers. comm.*, 1998) represent contour maps of the thicknesses of Christchurch Formation, and Springston Formation. Figure 3.7 to 3.14 (taken from DAVE SCOTT, *pers. comm.*, 1998) show contour maps, which indicate the depths to the top and the thicknesses of Riccarton Gravel, Linwood Gravel, Burwood Gravel and Wainoni Gravel.

Each aquifer can be characterised by its:

1. Transmissivity: The rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient. Assuming that the material of an aquifer is homogeneous and isotropic, the transmissivity is defined (FETTER, 1988) as:

$$T = K\,b$$

   where: b= thickness of the aquifer [m]
   K= hydraulic conductivity [m/day; m/sec]
   T= transmissivity [m^2/day;m^2/sec]

2. Specific storage: The volume of drained water, expressed as a percentage of the bulk volume.

$$S = S_y + h\,S_S$$

   where: h = thickness of saturated zone [m]
   Sy= specific yield [m^2]
   S_S= specific storage [1/m]

3. Storativity: The volume of water that a permeable unit will absorb or expel from storage per unit surface area per unit change in head.

$$S = S_S\,b$$

   where: S = storativity [dimensionless]
   S_S= specific storage [1/m]
   b = thickness of the aquifer [m]

Figure 3.15 to 3.18 (taken from CRC, 1997a) illustrate wells with pump test data for each aquifer and summarise the results. The mean value for each aquifer parameter has been calculated by validating the quality of each pump test in terms of:

- test type
- test duration
- verifiability
- data plot appearance
- analysis method
- correction
- data verifiability.

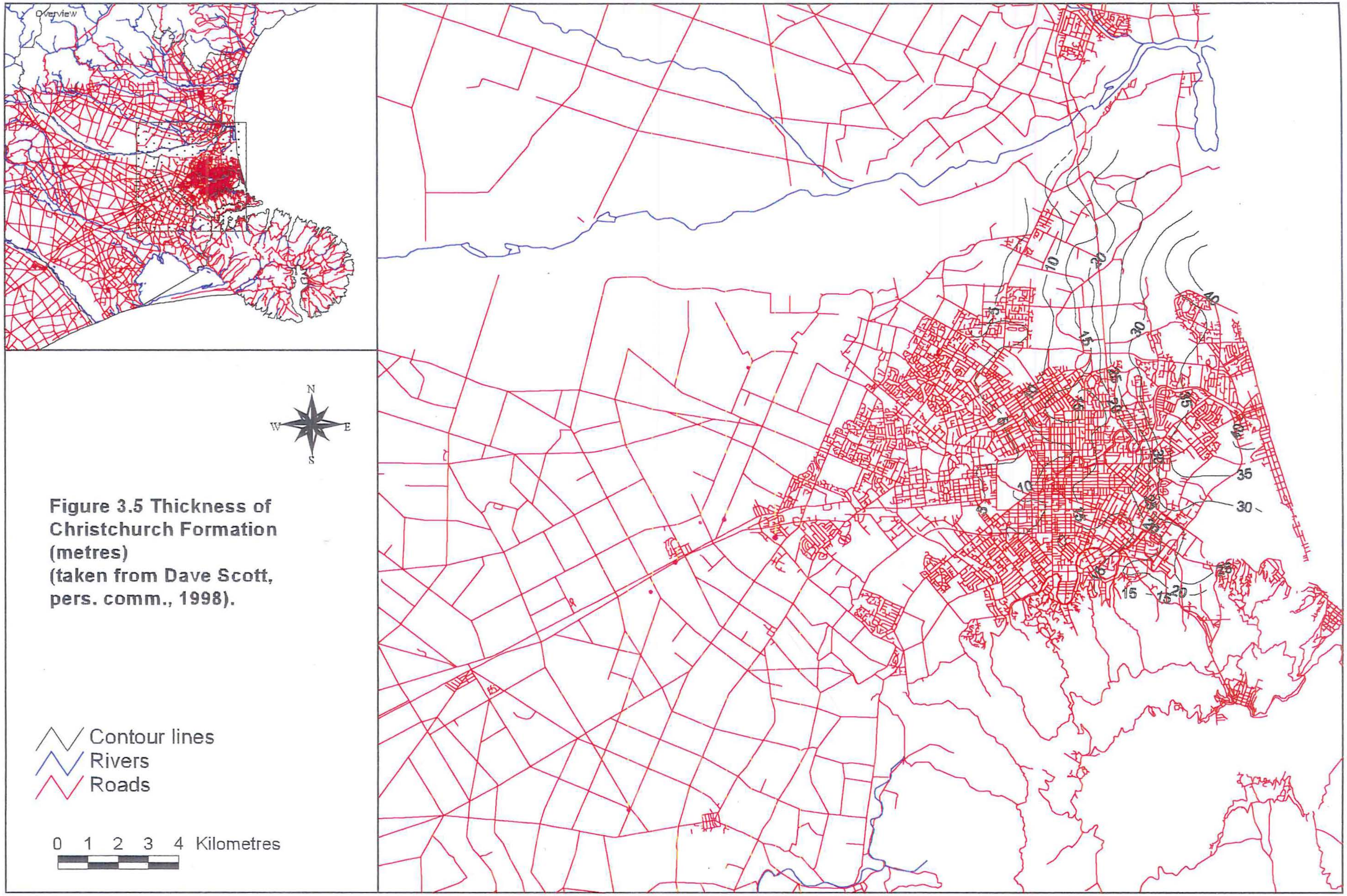


Figure 3.5 Thickness of Christchurch Formation (metres) (taken from Dave Scott, pers. comm., 1998).

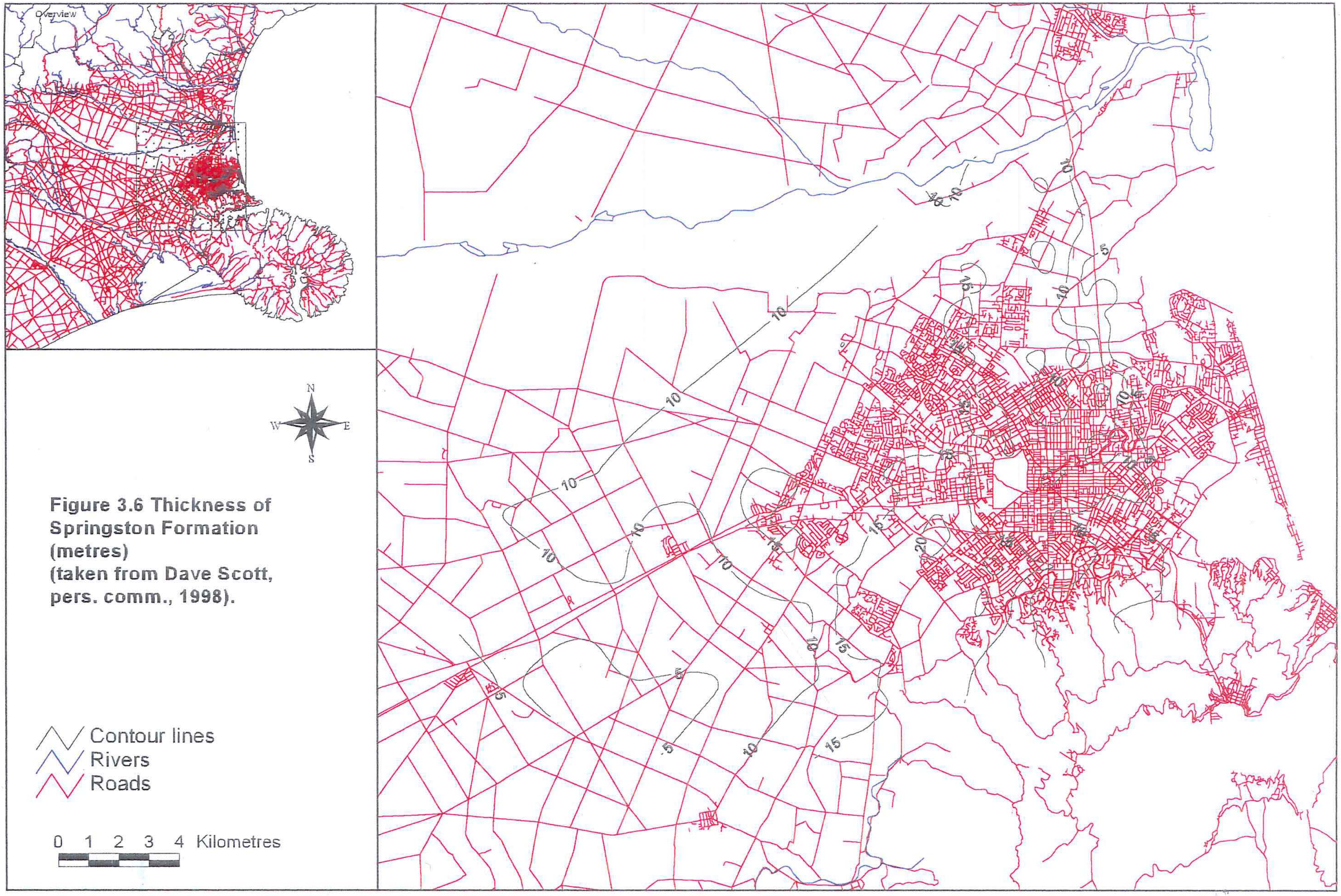


Figure 3.6 Thickness of Springston Formation (metres) (taken from Dave Scott, pers. comm., 1998).

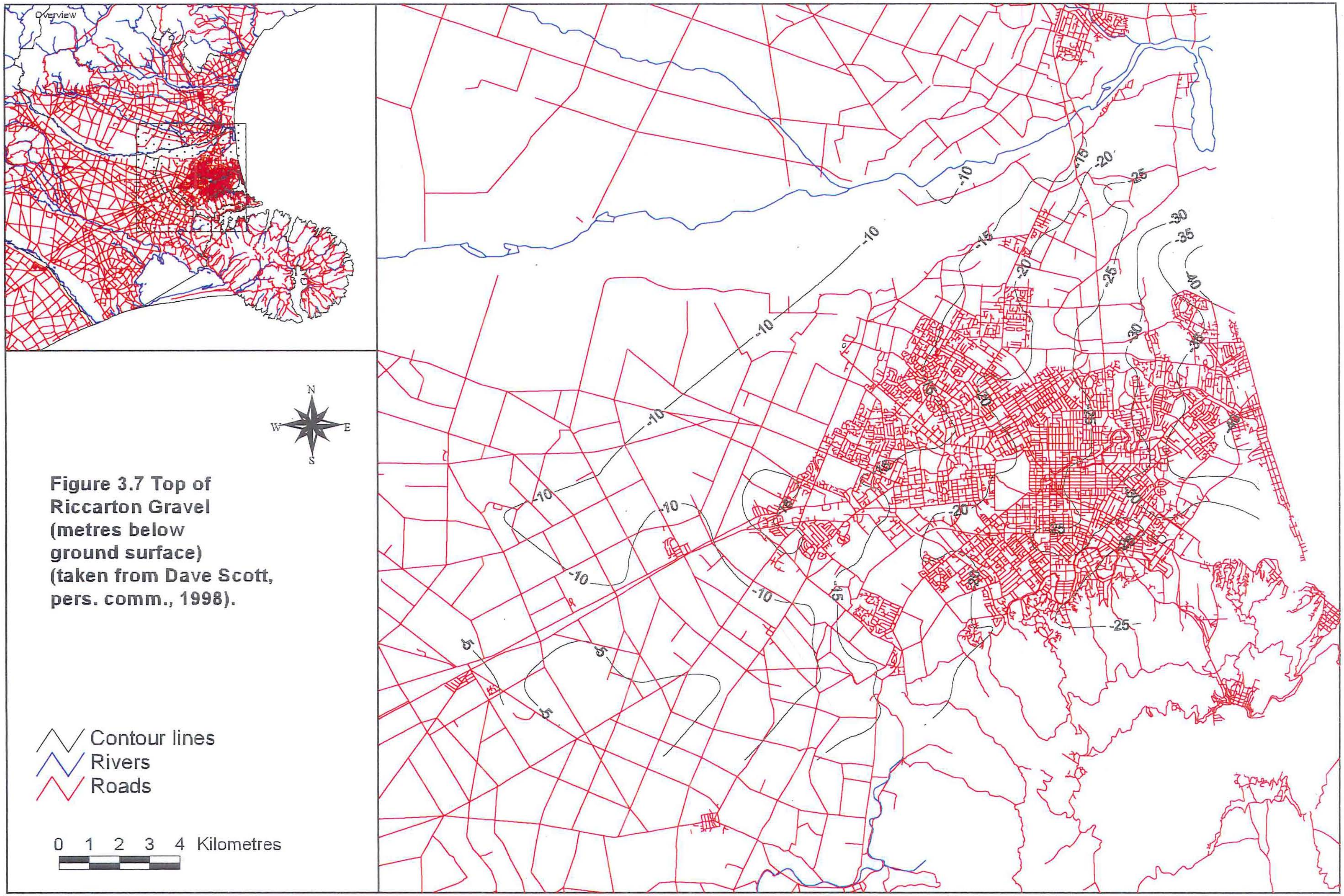


Figure 3.7 Top of Riccarton Gravel (metres below ground surface) (taken from Dave Scott, pers. comm., 1998).

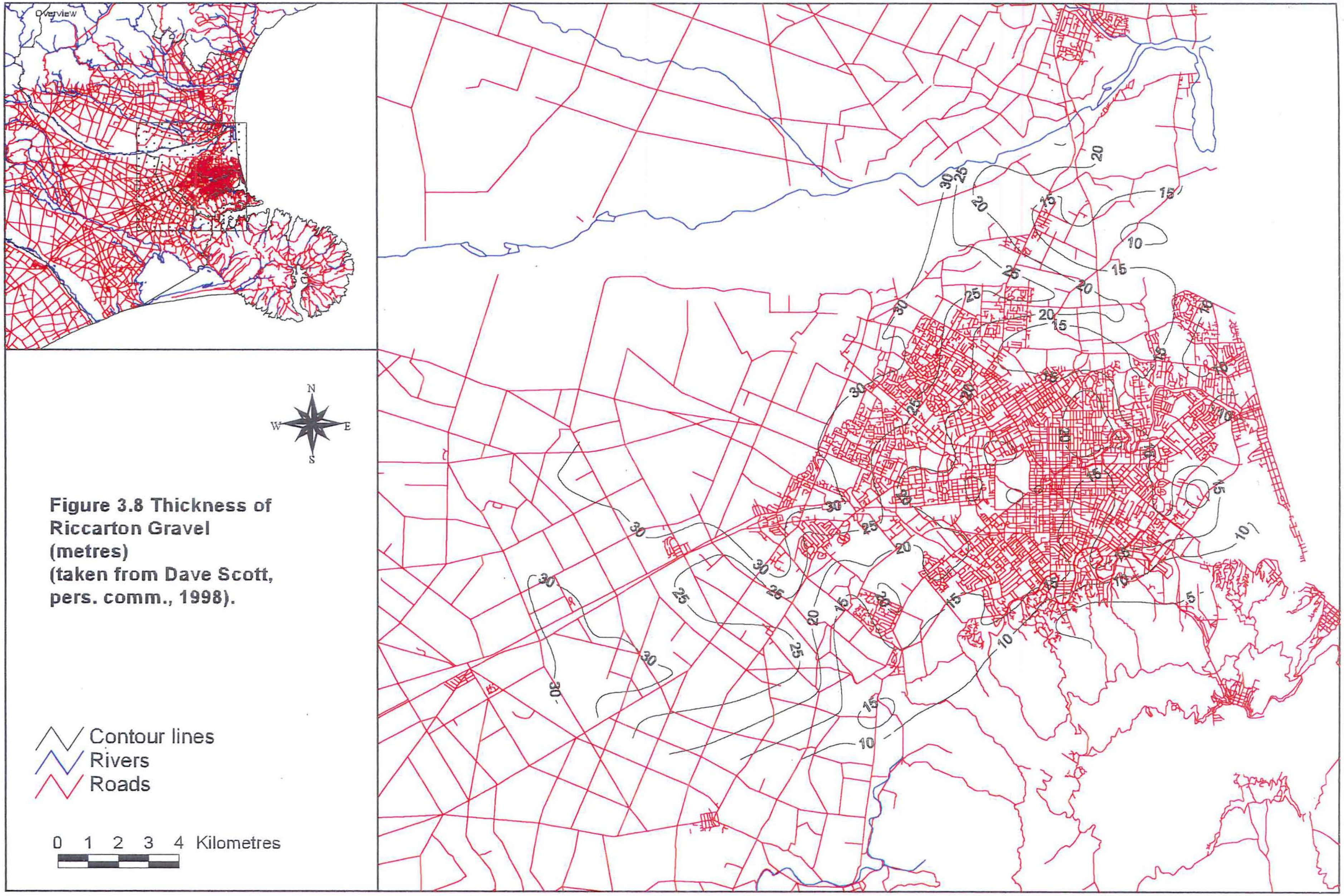


Figure 3.8 Thickness of Riccarton Gravel (metres) (taken from Dave Scott, pers. comm., 1998).

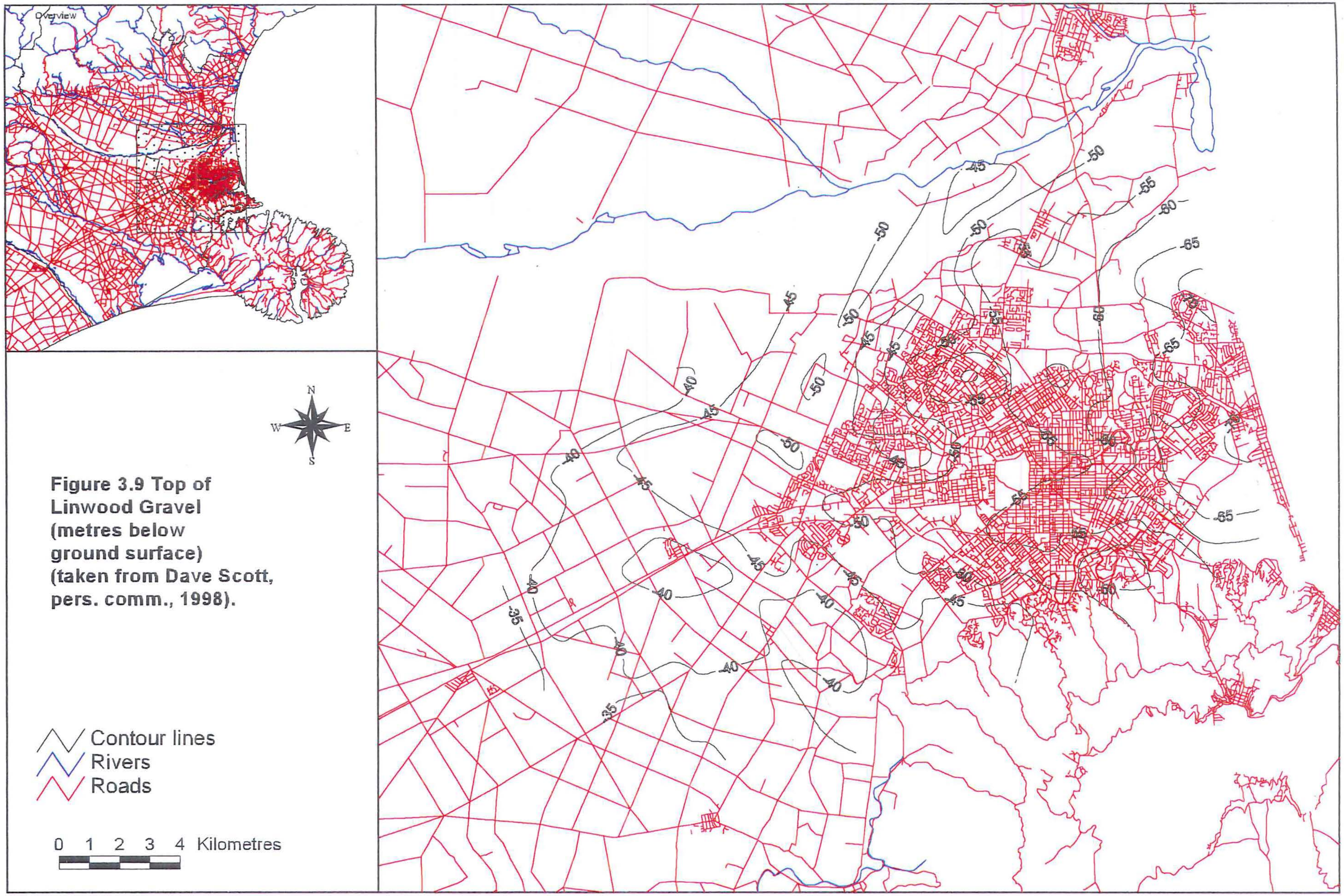


Figure 3.9 Top of Linwood Gravel (metres below ground surface) (taken from Dave Scott, pers. comm., 1998).

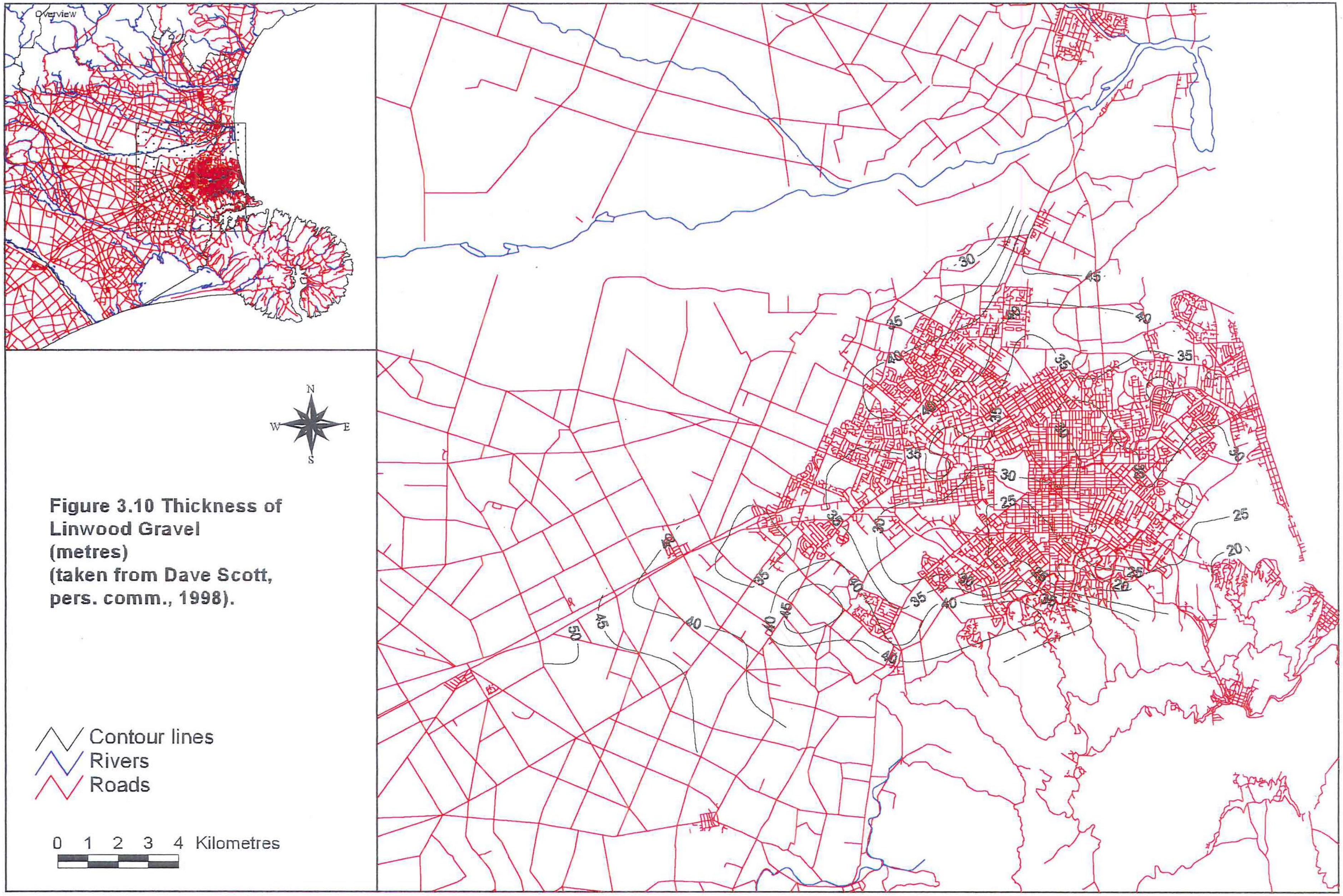


Figure 3.10 Thickness of Linwood Gravel (metres) (taken from Dave Scott, pers. comm., 1998).

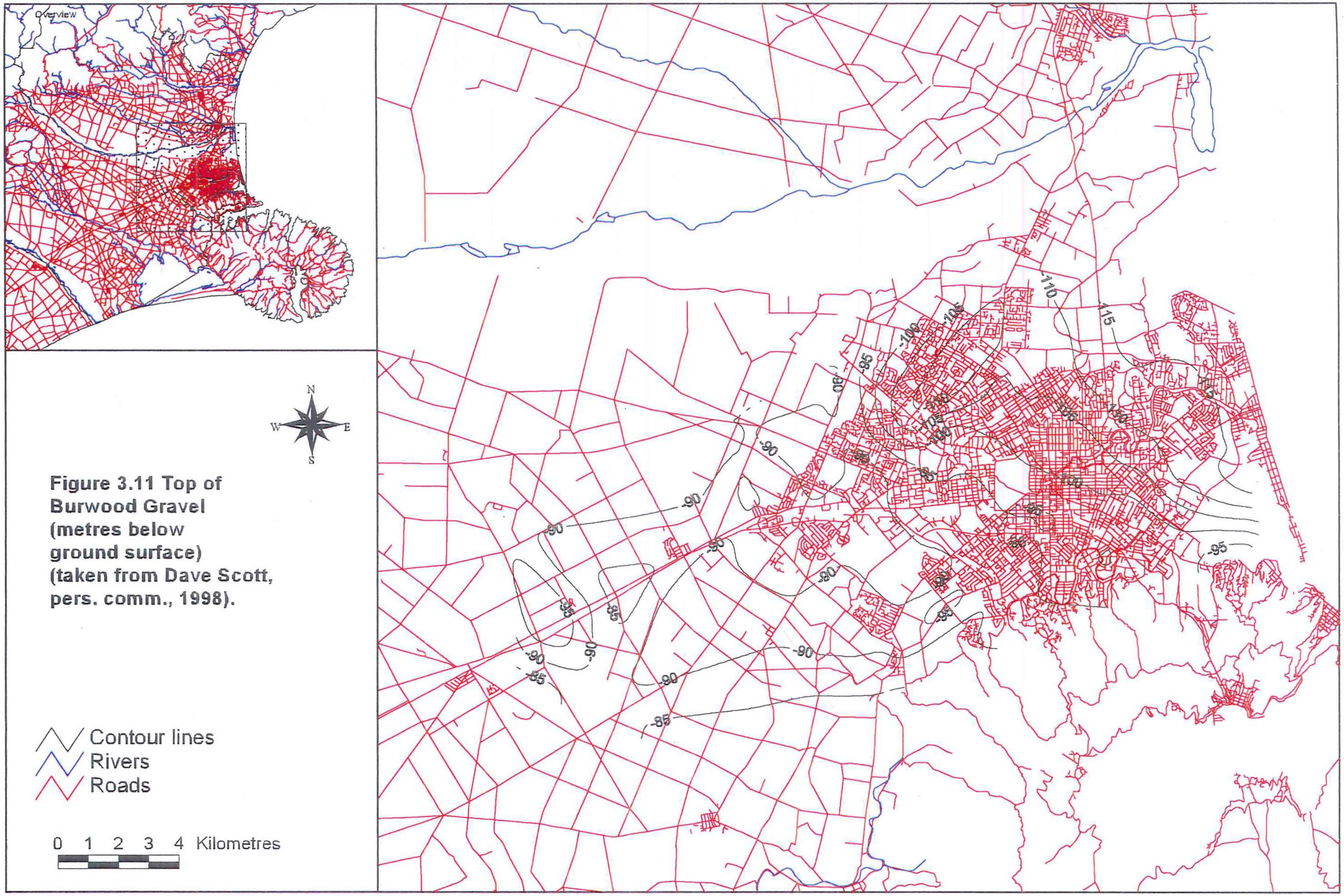


Figure 3.11 Top of Burwood Gravel (metres below ground surface) (taken from Dave Scott, pers. comm., 1998).

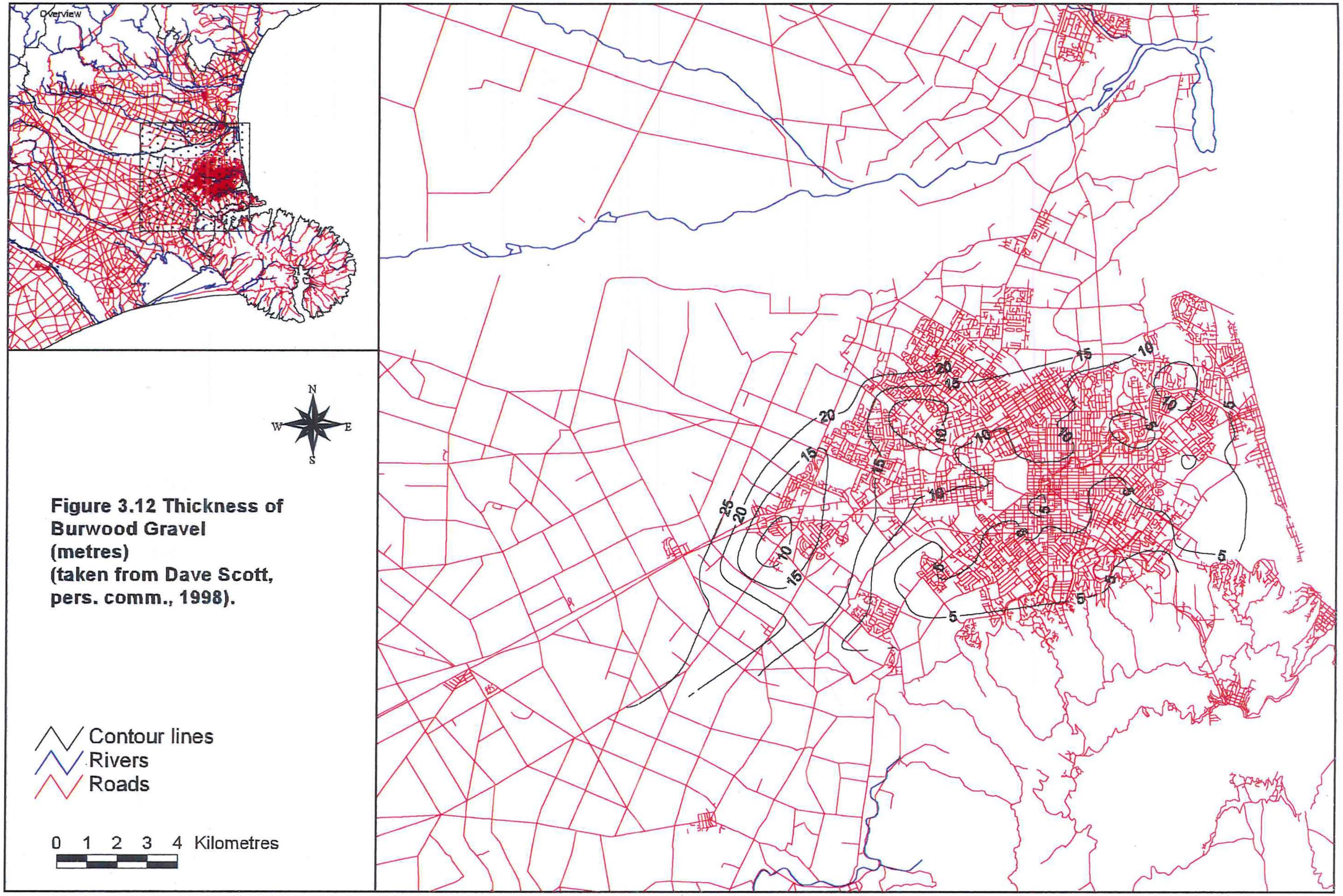


Figure 3.12 Thickness of Burwood Gravel (metres) (taken from Dave Scott, pers. comm., 1998).

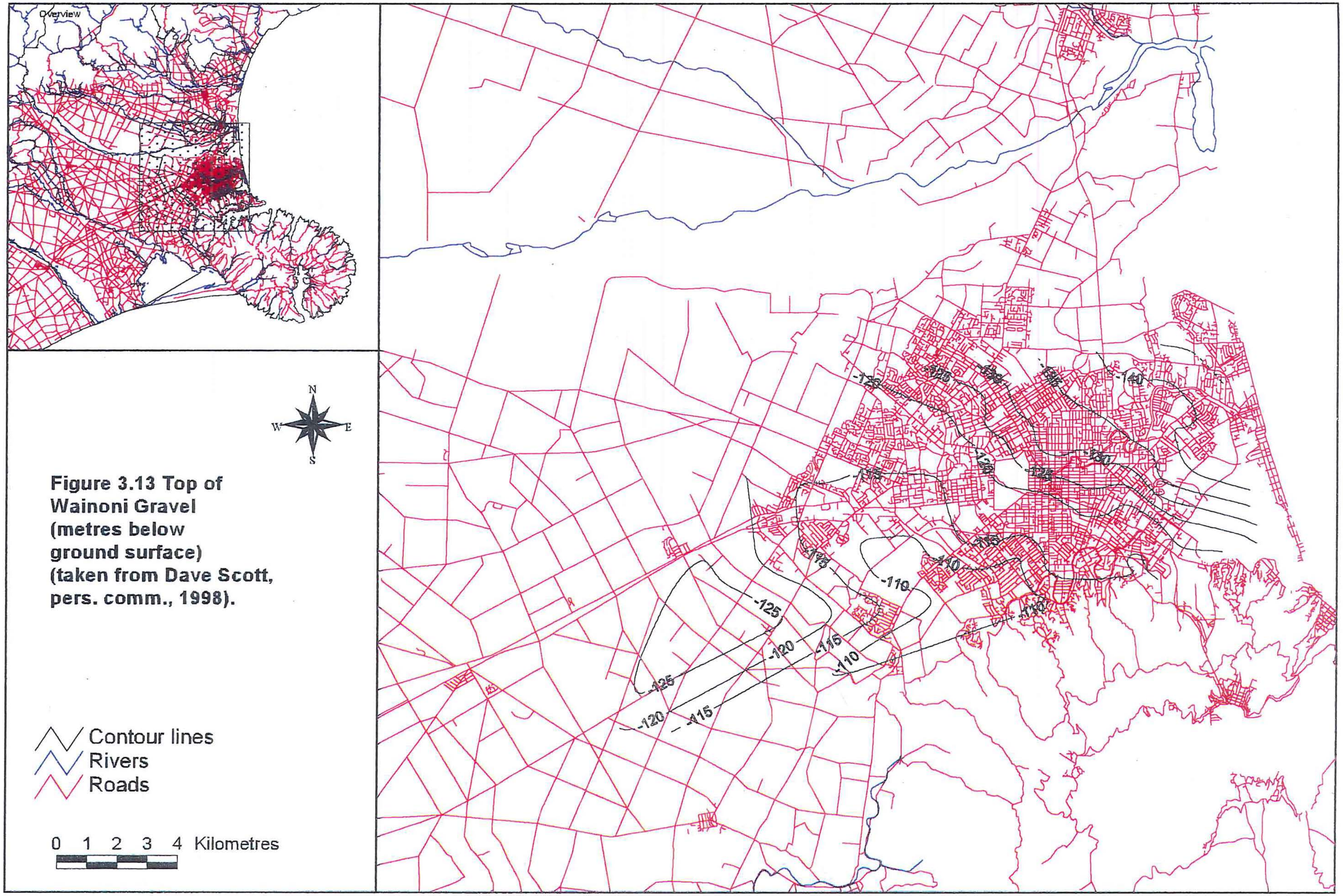


Figure 3.13 Top of Wainoni Gravel (metres below ground surface) (taken from Dave Scott, pers. comm., 1998).

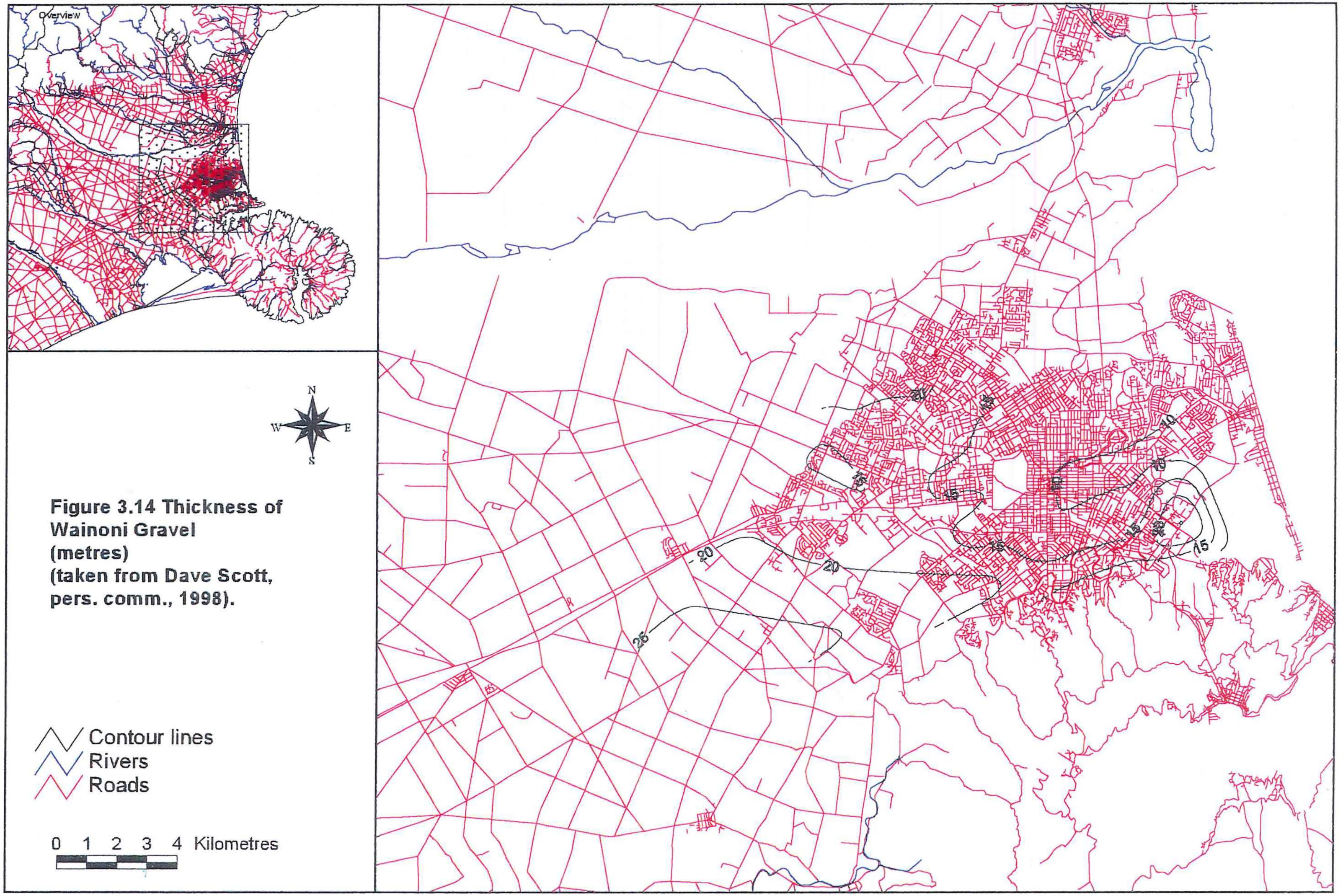


Figure 3.14 Thickness of Wainoni Gravel (metres) (taken from Dave Scott, pers. comm., 1998).

Well Number	M35/1154	M35/1171	M35/2236	M35/2454	M35/2557	M35/3136	M35/3168	M35/5557	M35/5648	M35/6107
T (m^2/day)	921	250	864	43200	43200	11491	1382	9072	2160	1380
k (m/day)	18	25	29	1440	1440	383	46	412	72	92
Storativity		6.0E-05		7.0E-06		4.0E-02		1.5E-04		1.6E-04

Well Number	M36/0175	M36/0516	M36/0864	M36/0979	M36/4591	**Mean**
T (m^2/day)	15600	2300	1569	290	5400	**3063**
k (m/day)	520	115	60	29	360	**134**
Storativity	1.0E-01	6.7E-05	2.3E-04	1.8E-03	5.2E-03	**6.87E-4**

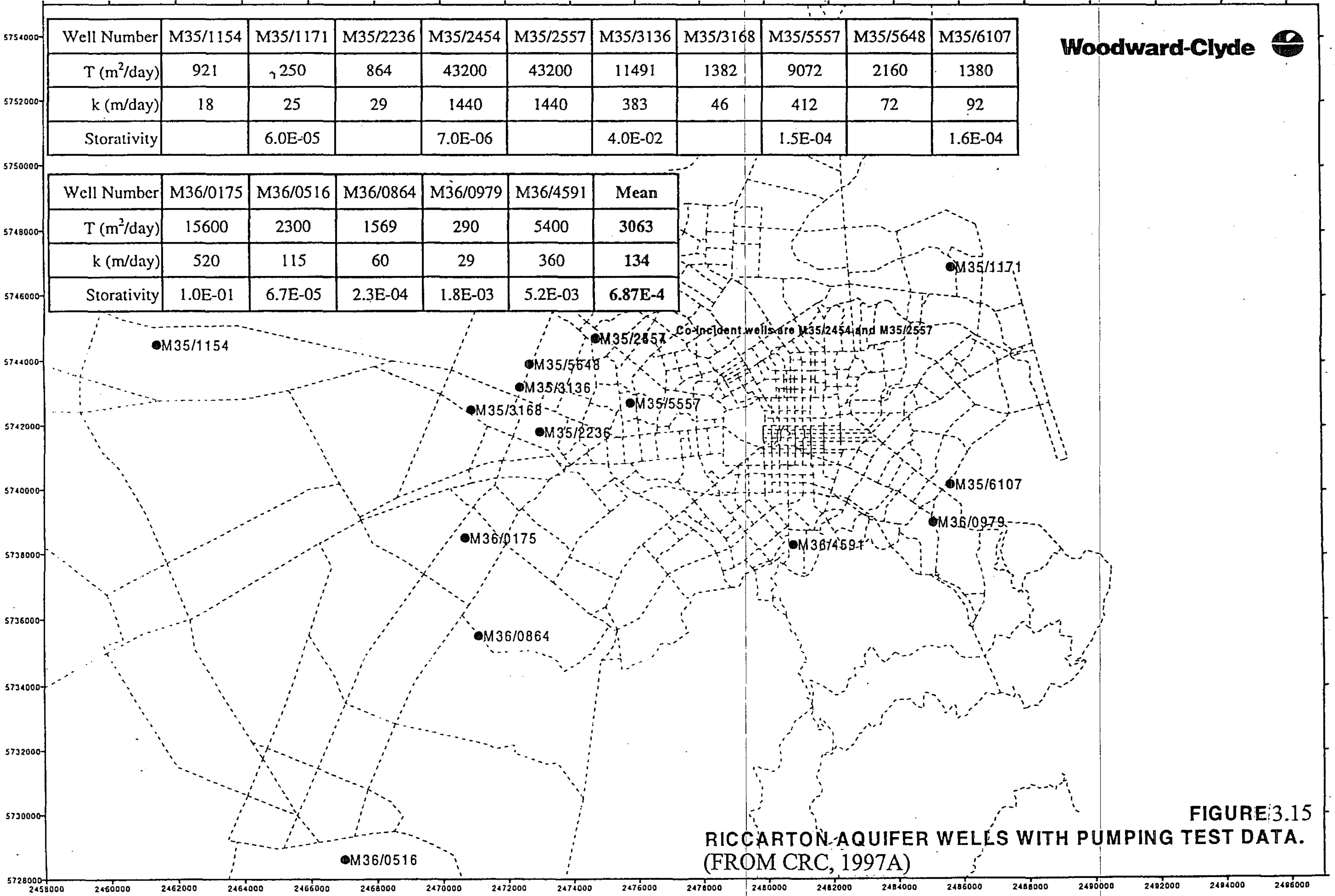


FIGURE 3.15
RICCARTON AQUIFER WELLS WITH PUMPING TEST DATA.
(FROM CRC, 1997A)

Woodward-Clyde

Well Number	M35/1104	M35/1684	M35/6201	M35/6213	M35/7180	M35/7237	M35/7291	M36/0028	M36/0045	M36/0226
T (m^2/day)	209	33	435	550	1382	411	3888	174	4160	36
k (m/day)										
Storativity			2.6E-04			8.7E-04	3.0E-06			

Well Number	M36/0261	M36/0929	M36/1249	M36/1268	M36/1323	M36/4578	M36/4595	**Mean**
T (m^2/day)	440	2330	2765	164	170	150	184	**403**
k (m/day)		63				5.5	9.2	**13**
Storativity			2.9E-05	6.6E-05		1.0E-04		**7.83E-5**

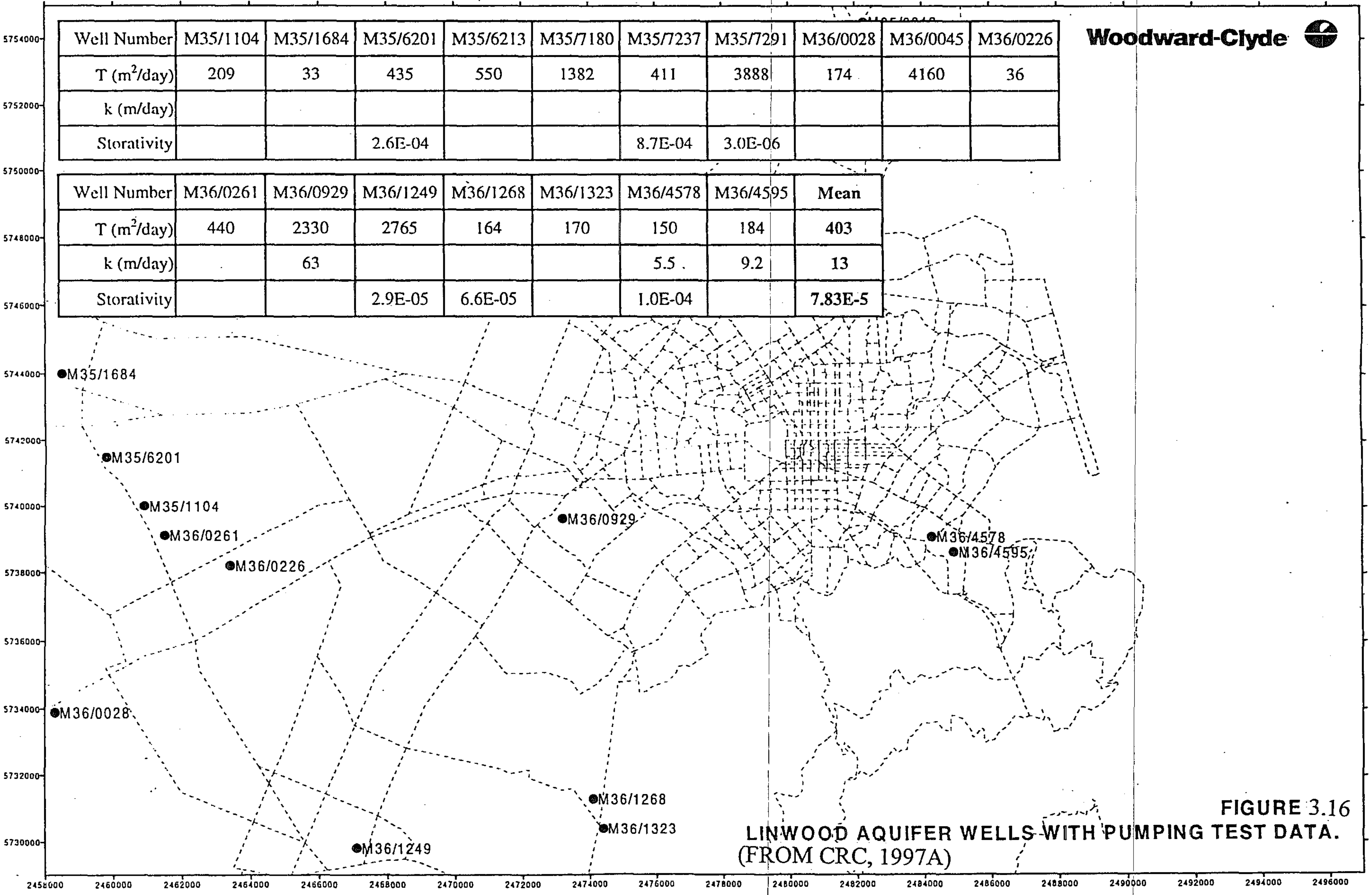


FIGURE 3.16
LINWOOD AQUIFER WELLS WITH PUMPING TEST DATA.
(FROM CRC, 1997A)

Well Number	M35/2646	M36/2559	M36/2856	M36/4795	**Mean**
T (m^2/day)	6274	218	5290	184	**1726**
k (m/day)	1046	12.2			**7**
Storativity	2.6E-04	0.0E+00	3.0E-06	2.9E-05	**3.63E-5**

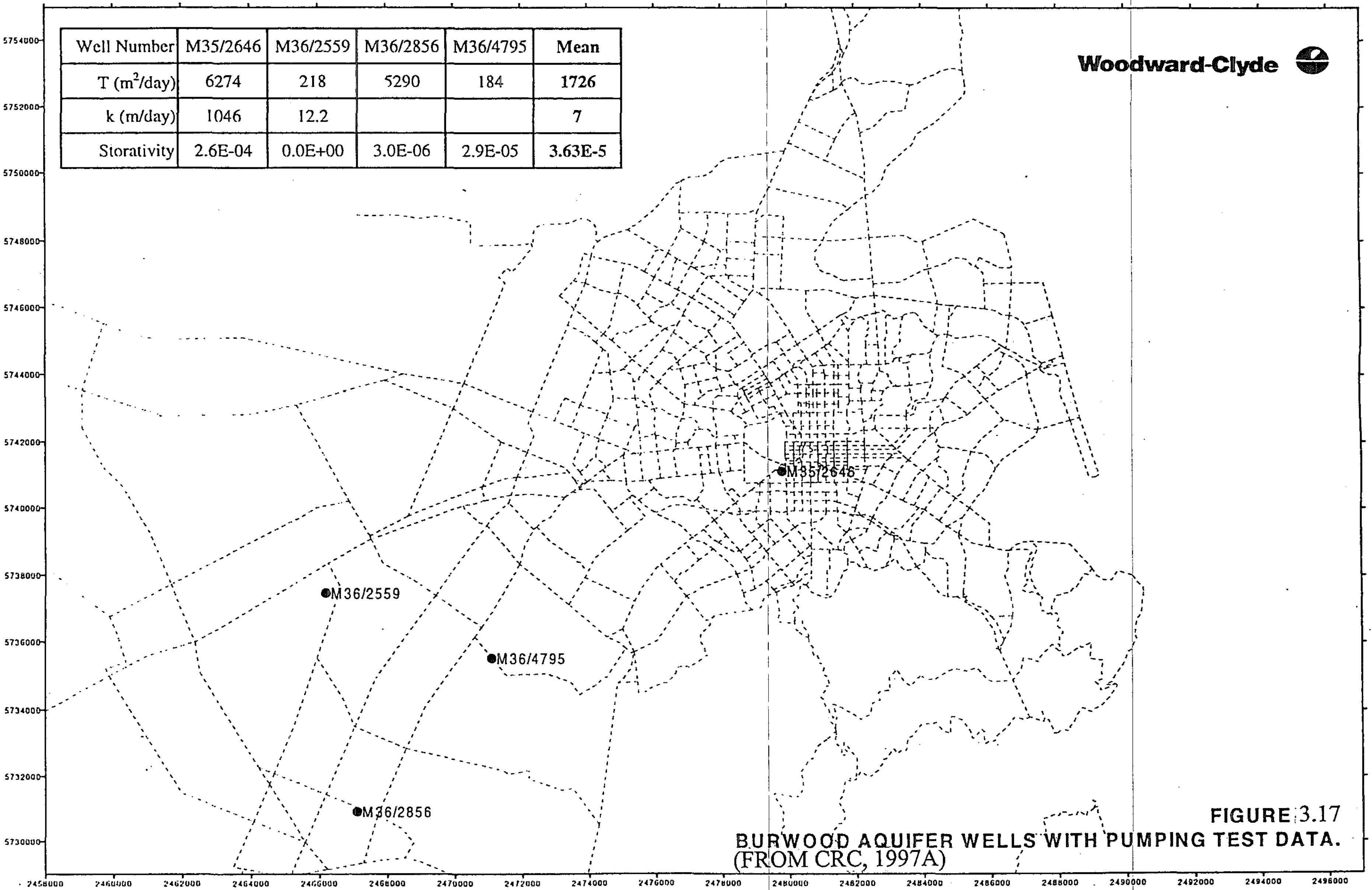


FIGURE 3.17
BURWOOD AQUIFER WELLS WITH PUMPING TEST DATA.
(FROM CRC, 1997A)

Well Number	M35/1384	M35/2081	M35/2534	M35/3813	M35/5135	M35/5830	M35/6038	M36/0930	M36/1817	Mean
T (m^2/day)	8064	775	3700	3070	760	630	6480	596	2680	**1991**
k (m/day)	806	77.5	264	256	35		648	28		**165**
Storativity					4.6E-04		6.3E-05			**1.59E-4**

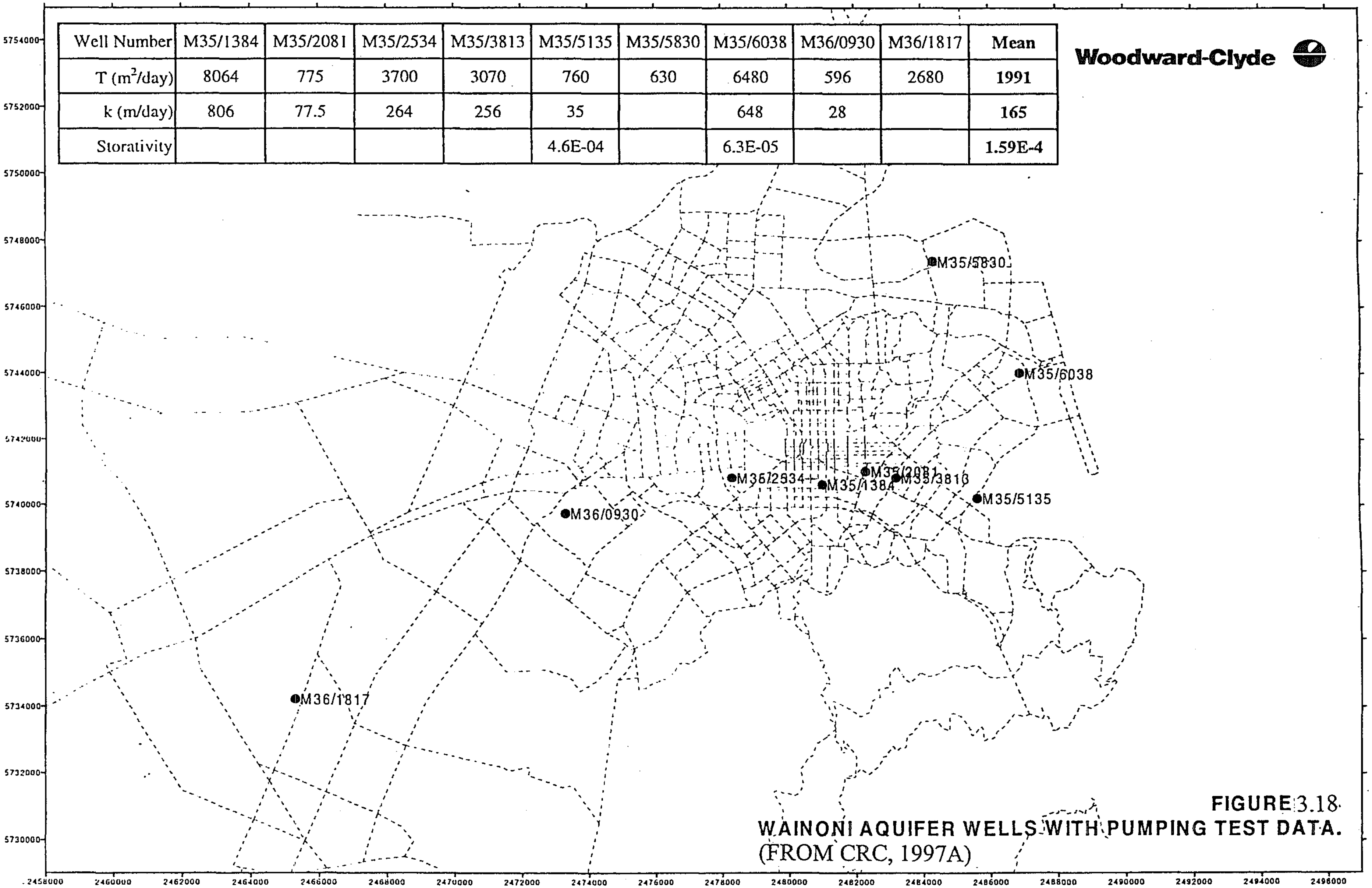


FIGURE 3.18
WAINONI AQUIFER WELLS WITH PUMPING TEST DATA.
(FROM CRC, 1997A)

In the Canterbury Plains, the transmissivity of the aquifer system decreases with depth as shown on Figure 3.19 (THORPE and SCOTT, 1991). The hydraulic conductivity of the aquifers increases towards the coast. This is a consequence of an increasing degree of sorting and consequent increase in permeability of the unconsolidated sediments as they have been transported toward the coast.

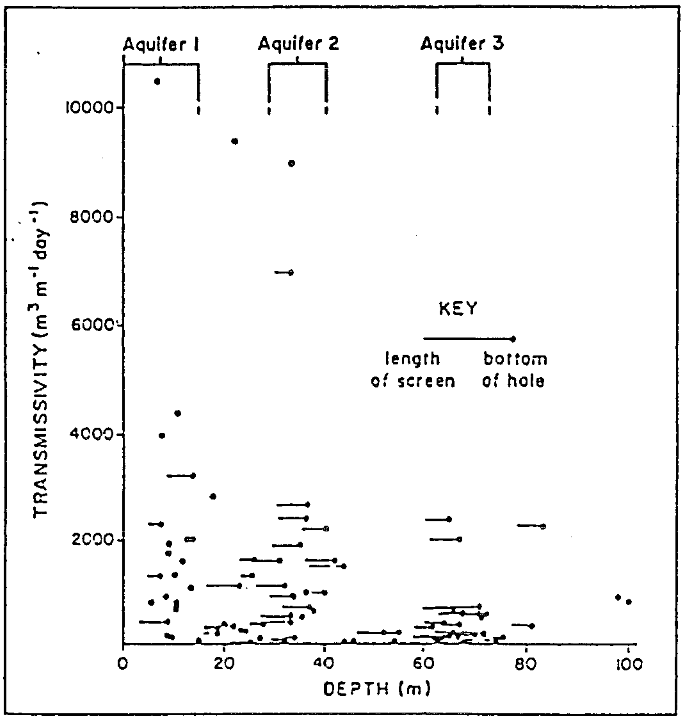


Figure 3.19 The variation of transmissivity with depth beneath the Canterbury Plains (SCOTT, 1980, taken from SCOTT AND THORPE, 1991).

The leakance of a confining layer is a quantitative description of its ability to impede vertical groundwater movement. It is defined (ESSAID, 1990b) as:

$$\text{Leakance} = K'/b'$$

where: K'= vertical hydraulic conductivity of the aquitard [m/s; m/day]

b'= thickness of the aquitard [m]

Leakance values were obtained from pump tests, which had been conducted on wells within the confined aquifers. The pump tests were reviewed by Tom Brooks from the Canterbury Regional Council to obtain leakance values. He stressed that the least reliable values are for K' because there was less confidence with discerning confining layer thickness (b'). The following errors may also be associated with the aquifer tests:

- Tidal effects may not be corrected for.
- Variable lithology may mean that pumping well and observation wells are not open to the same aquifer.
- Large variability in results (which may be reasonable or unreasonable).

The results are shown in Table 3.1. For pumping well locations see Figure 3.15 to 3.18.

Pumping well	Aquifer test reliability	T [m/day]	S	K'/b' [day^{-1}]	b' [m]	K' [m/day]
M35/1171 (Riccarton Aquifer)	unreliable	500	0.000002	0.00002	30	0.0006
M35/1171 (Riccarton Aquifer)	some reliability	260	0.00001	0.002	30	0.06
M36/0979 (Riccarton Aquifer)	unreliable	290	0.0018	-		-
M35/6107 (Riccarton Aquifer)	some reliability	1300	0.0002	-	-	-
M36/4578 (Linwood Aquifer)	some reliability	150	-	-	-	-
M36/4595 (Linwood Aquifer)	some reliability	173	-	-	-	-
M35/2646 (Burwood Aquifer)	unreliable	6700	-			-
M35/6038 (Wainoni Aquifer)	some reliability	3000	0.00001	0.0003	17	0.005

Table 3.1 Results of pump tests which were reviewed to determine leakance (from BROOKS, *pers. comm.*, 1997).

Obviously reliable leakance data are sparse. The leakance value of 0.002 day^{-1} from an aquifer test of the Riccarton Aquifer is relatively small. The lower value of 0.0003 day^{-1} for the Wainoni Aquifer could be due to the compression of the aquifer with depth. However, the data are too sparse to draw any meaningful conclusions. More data are needed to determine how leaky the confining layers are. This has important implications on how vulnerable the aquifers are to groundwater contamination from overlying and underlying contaminant sources.

3.4 Hydrogeology of the study area

A number of reasons for a limited groundwater availability in the Heathcote area have been identified:

1. The thickness of the uppermost aquifer (Aquifer 1) is only about 5-10m compared to about 15-25m elsewhere in Christchurch (WEEBER, 1993).
2. Aquifer 2 is partly missing in the study area and thus does not recharge Aquifer 1 to the same degree as elsewhere. (WEEBER, 1993).
3. The location of the study area is close to Banks Peninsula. Groundwater flow along the northern margin of Banks Peninsula is directed parallel to Banks Peninsula (see Figure 3.3). A ridge of Banks Peninsula rocks, which reaches an altitude of 288m, occurs to the west of the study area. Potentiometric contours indicate that it is likely to limit recharge to the study area.
4. A volcanic sea stack beneath the study area was identified by WEEBER (1993). It was suggested that this sea stack could limit groundwater recharge to the study area. It was proposed that connate seawater or groundwater derived from the sea stack might affect the groundwater quality in the study area. A contour map and cross-sections of the volcanic sea stack are shown in Figure 3.20.

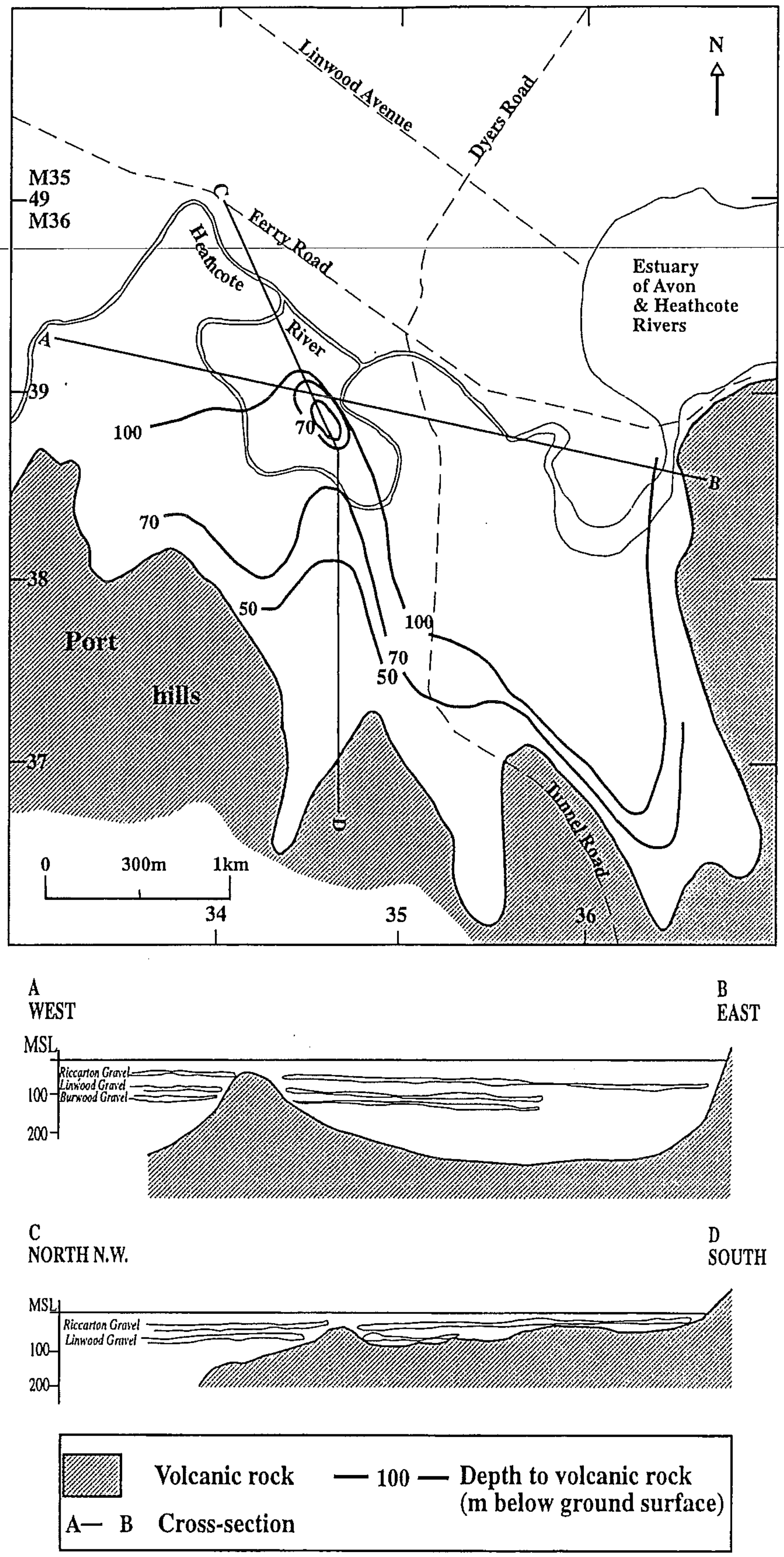


Figure 3.20 Depth contours and cross-sections of the Woolston buried volcanic ridge/sea stack complex (redrawn from WEEBER, 1993).

3.5 Christchurch groundwater quality

In general Christchurch groundwater is known for its excellent quality and can be regarded as its most precious natural resource. The water originates from the rain and snow which falls upon the Southern Alps. Rivers emerging at the foothills of this largely uninhabited mountain range recharge it continuously to the multilayered aquifer system of the Canterbury Plains. The aquifer system is confined along the coastal plains as illustrated on Figure 3.3 protecting it from pollution from the surface. No treatment is needed for potable Christchurch groundwater as it is abstracted from deep good quality aquifers.

Results from a region wide groundwater quality sampling programme (Smith, 1995) which has been undertaken yearly by the Canterbury Regional Council since 1986 and includes approximately 159 shallow unconfined and 34 deeper confined wells indicate that:

- Chloride concentrations range from 0.50-140 mg/l with a mean of 12 mg/l, decrease with depth, and are below drinking guidelines.
- Sulphate concentrations range from 0.2-76 mg/l with a mean of 11 mg/l, decrease with depth, and are significantly below drinking guidelines.
- Nitrate-Nitrogen concentrations range from 0.005 -16.0 mg/l with a mean of 3.8 mg/l. The upper values were often obtained from groundwater at sites affected by close sources of nitrate contamination e.g., sewage discharges.
- Deeper (confined) groundwater is typically free from microbial contamination.

3.6 Groundwater quality in the study area

Groundwater from Aquifer 1 wells in the Heathcote Valley area is saline. Chloride concentrations up to 1100mg/l compared to 2-8mg/l for central and eastern Christchurch have been recorded (Weeber, 1993). Talbot *et al.* (1986) reported that the salinity of the groundwater from wells in the Heathcote area was increasing, implying that localised seawater intrusion might occur. However, their report was only based on 3 water samples which is regarded as insufficient to draw any meaningful conclusions (Weeber, 1993). This leaves ill-defined the source of the high chloride concentrations from groundwater within the study area (Weeber, 1993).

4 Groundwater contamination in the Woolston/Heathcote area

4.1 Trends in groundwater quality

Groundwater contamination within the Woolston/Heathcote area has been detected over the past 20-30 years as evidenced by an increasing salinity of the water. Increasing concerns about the quality have led the Canterbury Regional Council to increase the sampling frequency over recent years. Figure 4.1 illustrates the location of Aquifer 1 wells in the study area, which were sampled for groundwater quality on a long-term basis. In Figures 4.2 a-h the conductivity and concentrations of major ions of water from these wells are plotted versus time starting approximately in 1973. Groundwater from most wells shows an obvious increasing trend of major ion concentrations over this period. The highest degree in salinity is observed from groundwater from the well M36/1159. Chloride concentration increased from approximately 170mg/l in 1979 to about 1700mg/l in 1994 exceeding the New Zealand Drinking-Water Guideline for chloride concentration of 250mg/l. In order to obtain an appreciation of the magnitude of the groundwater contamination, the chemical data of one uncontaminated Aquifer 2 well (M36/1024) located within the study area has also been plotted. The groundwater quality of water from Aquifer 1 and Aquifer 2 wells is similar in the study area, so the chemical data of groundwater from the well M36/1024 acts as an ambient groundwater reference. The maximum acceptable values of the major ion concentrations as recommended by the New Zealand Drinking-Water Guideline are also shown on the graphs.

The locations of all sampled wells in and around the study area are shown in Appendix A.1. The water quality of groundwater from the sampled wells relevant for this thesis is given in Appendix A.2.

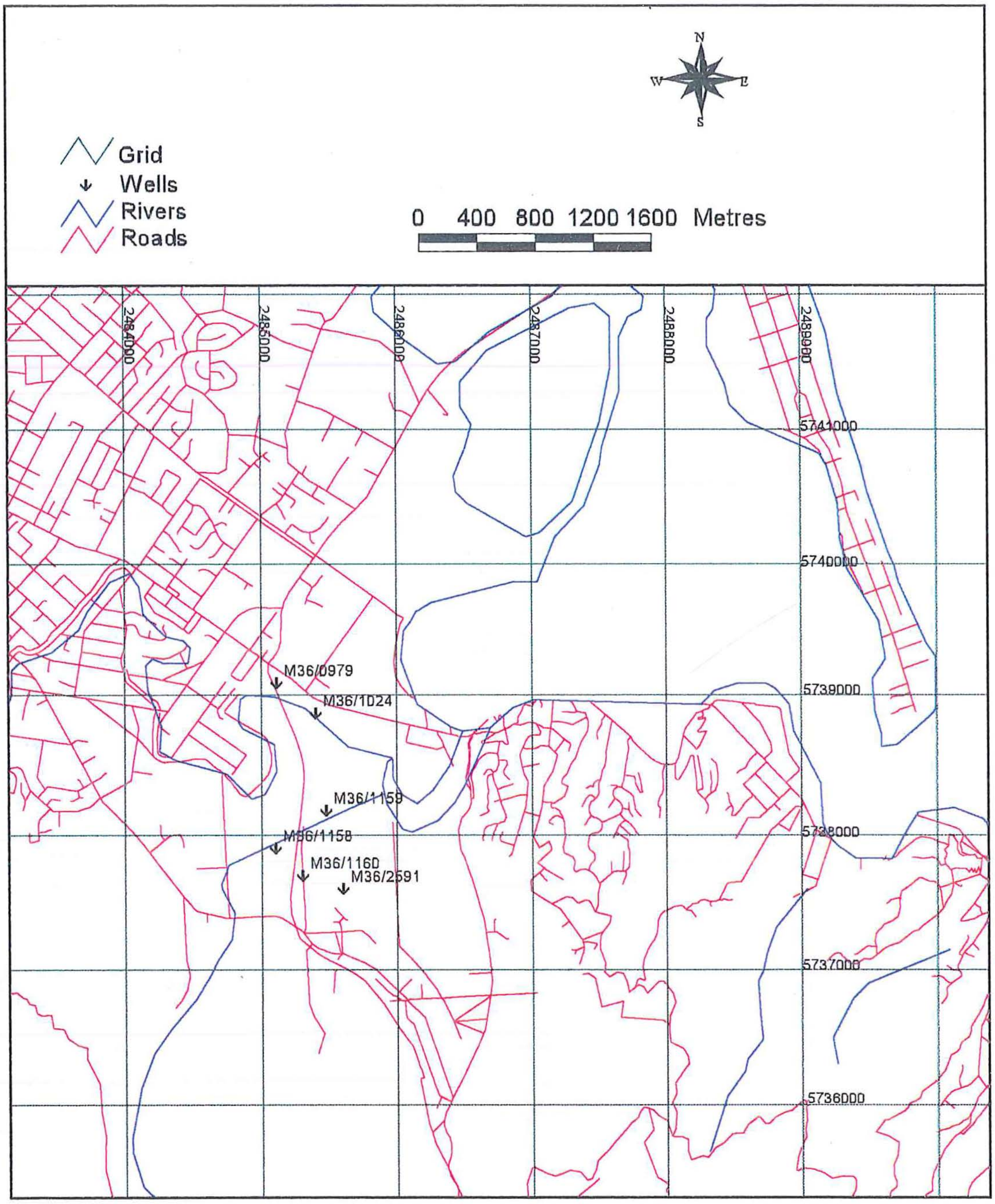


Figure 4.1: Location of long-term water quality monitoring wells in the Heathcote Valley.

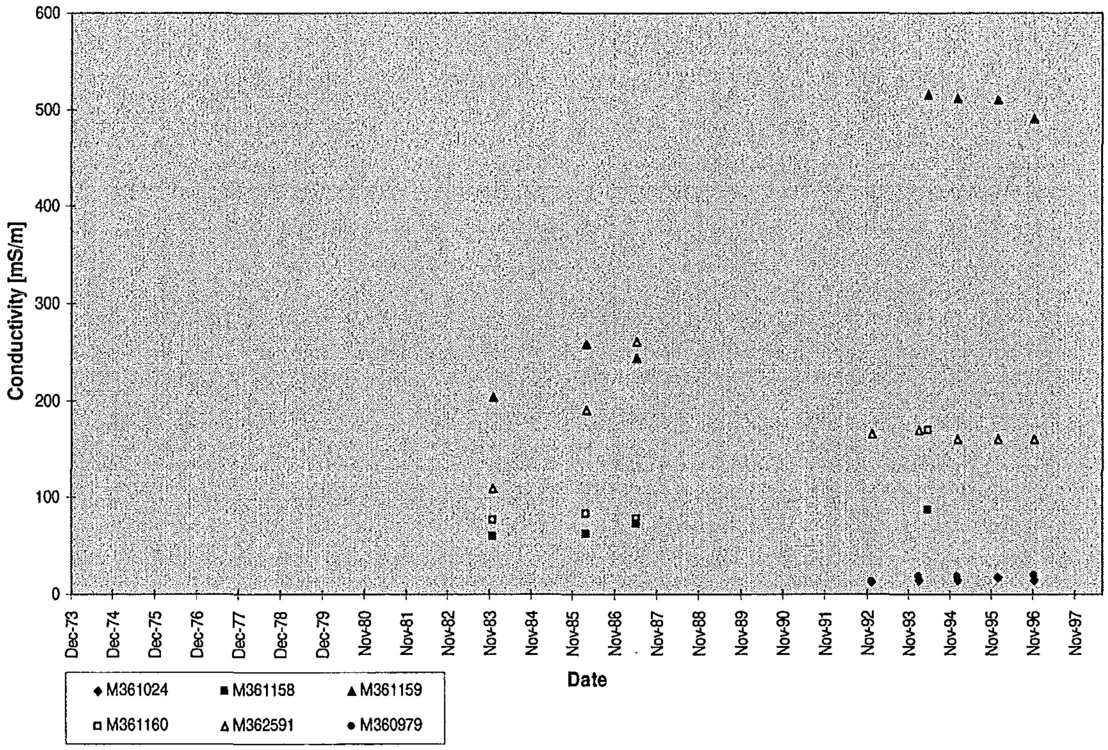


Figure 4.2a Trends in groundwater conductivity from long-term monitoring wells in the Heathcote Valley.

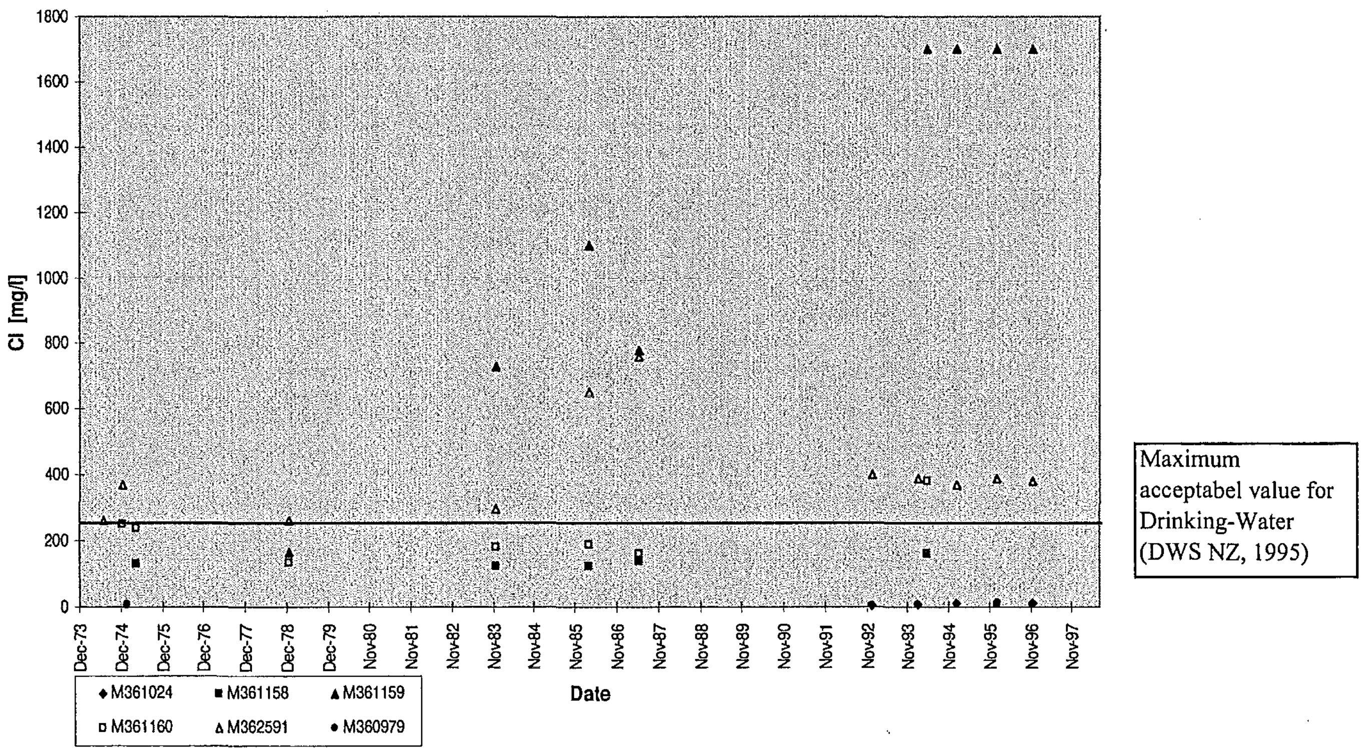


Figure 4.2b Trends in chloride concentrations in groundwater from long-term monitoring wells in the Heathcote Valley.

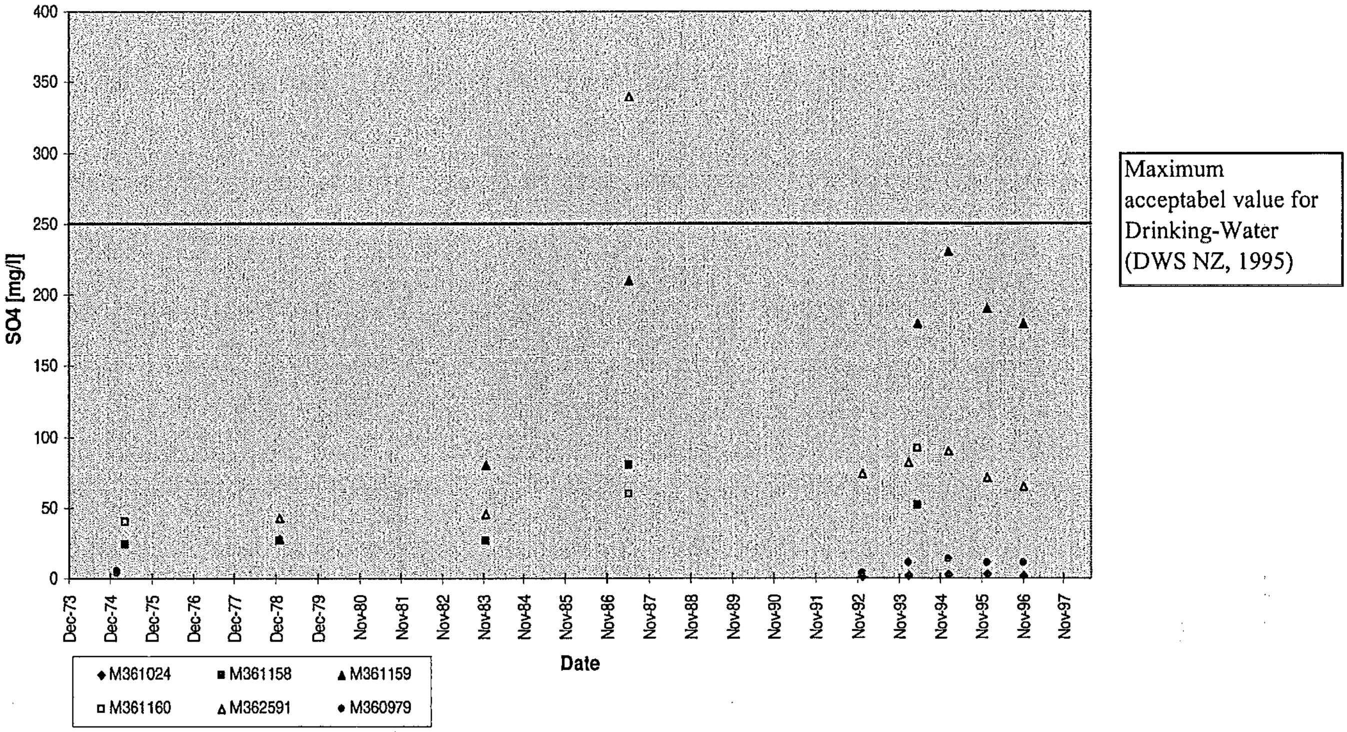


Figure 4.2c Trends in sulfate concentrations in groundwater from long-term monitoring wells in the Heathcote Valley.

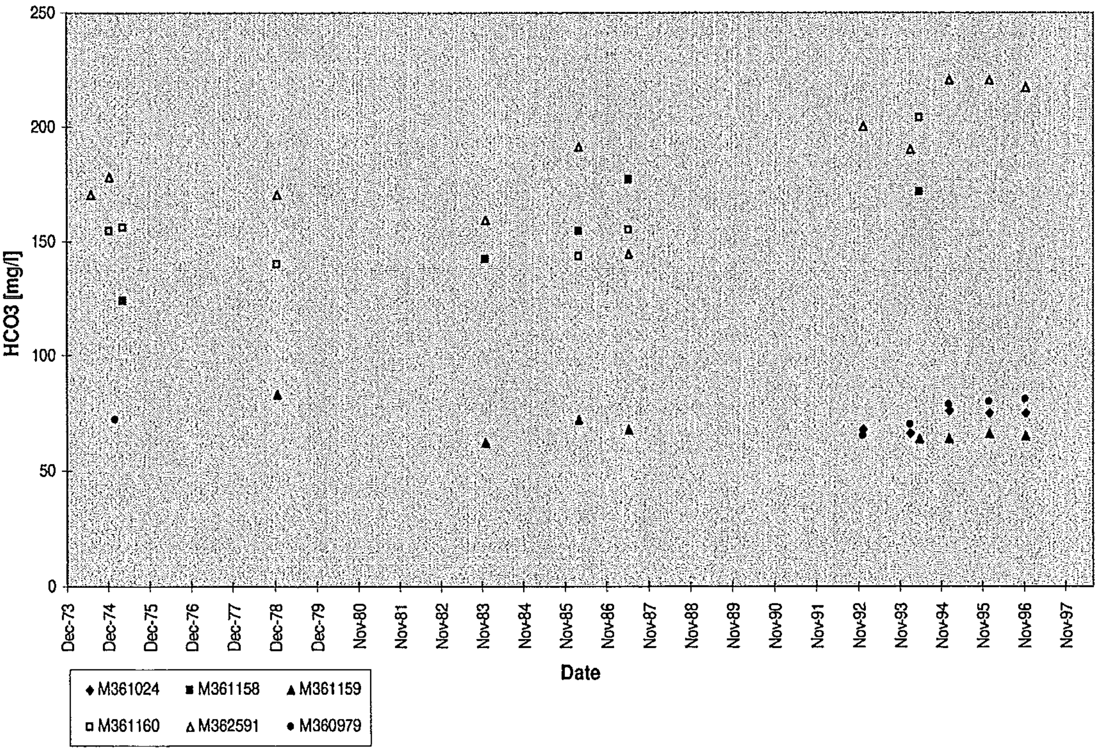


Figure 4.2d Trends in bicarbonateconcentrations in groundwater from long-term monitoring wells in the Heathcote Valley.

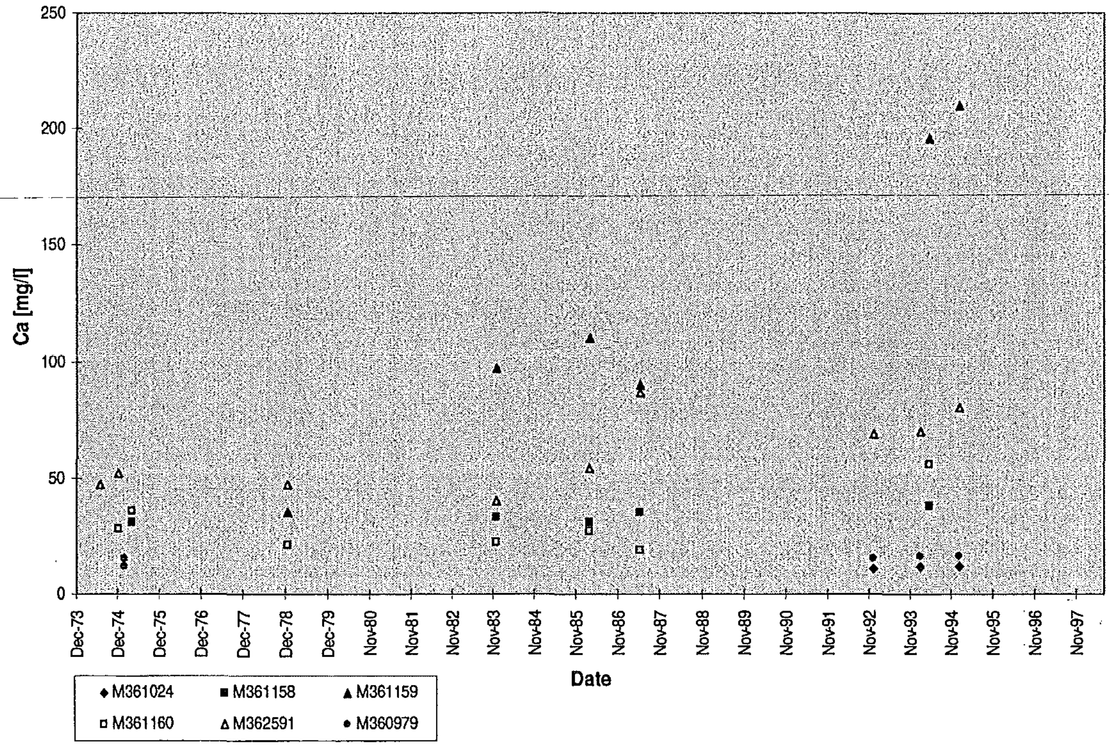


Figure 4.2e Trends in calcium concentrations in groundwater from long-term monitoring wells in the Heathcote Valley.

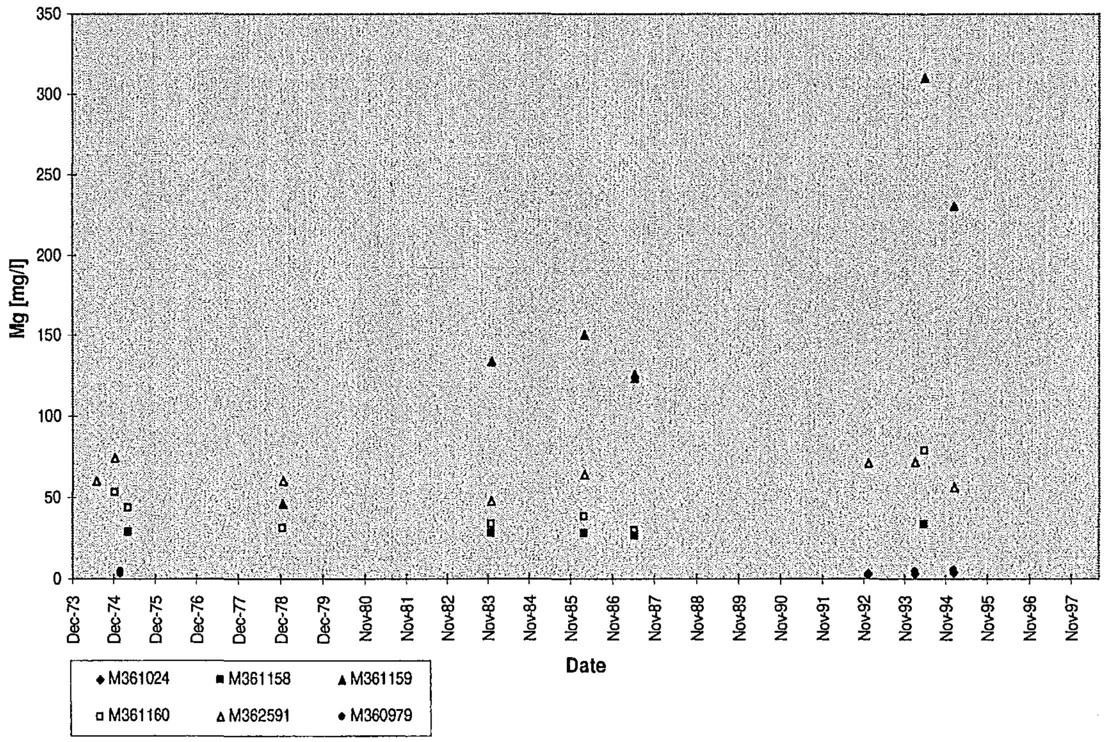


Figure 4.2f Trends in magnesium concentrations in groundwater from long-term monitoring wells in the Heathcote Valley.

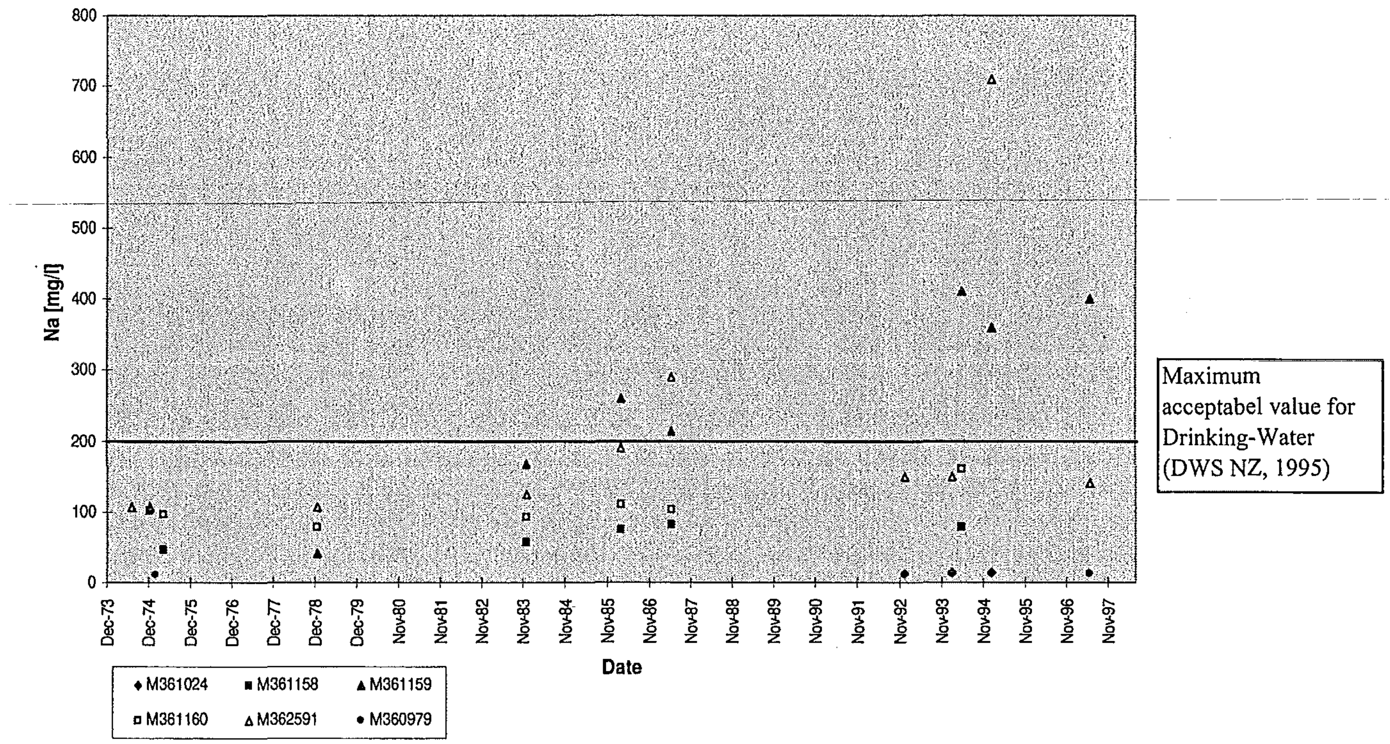


Figure 4.2g Trends in sodium concentrations in groundwater from long-term monitoring wells in the Heathcote Valley.

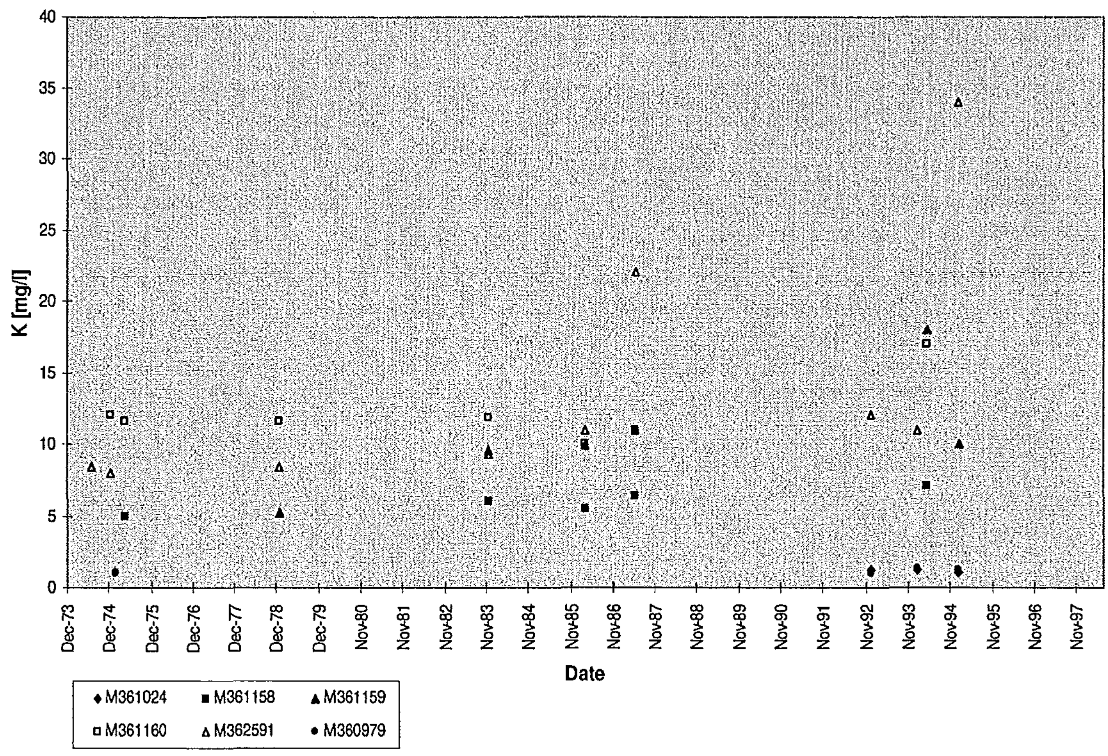


Figure 4.2h Trends in potassium concentrations in groundwater from long-term monitoring wells in the Heathcote Valley.

4.2 Spatial extent of groundwater contamination

The chloride content of ambient Christchurch groundwater in each aquifer is generally very low (approximately 0-10mg/l). Groundwater contamination in the Woolston/Heathcote area has led to increased chloride concentrations of up to 1700mg/l. Chloride concentrations of groundwater from wells in the area have therefore been used to determine the approximate spatial extend of groundwater contamination. Figure 4.3 and Figure 4.4 shows chloride concentrations of groundwater from Aquifer 1 and 2 wells, respectively. The locations of the sampled wells are displayed and the most recent groundwater quality data (see Appendix A.2) obtained for each well were used. The map for Aquifer 1 indicates that the area in the Heathcote Valley close to the estuary mainly exhibits high chloride concentrations. Unfortunately no Aquifer 2 wells exist in the area where groundwater from Aquifer 1 wells shows the greatest extend of contamination.

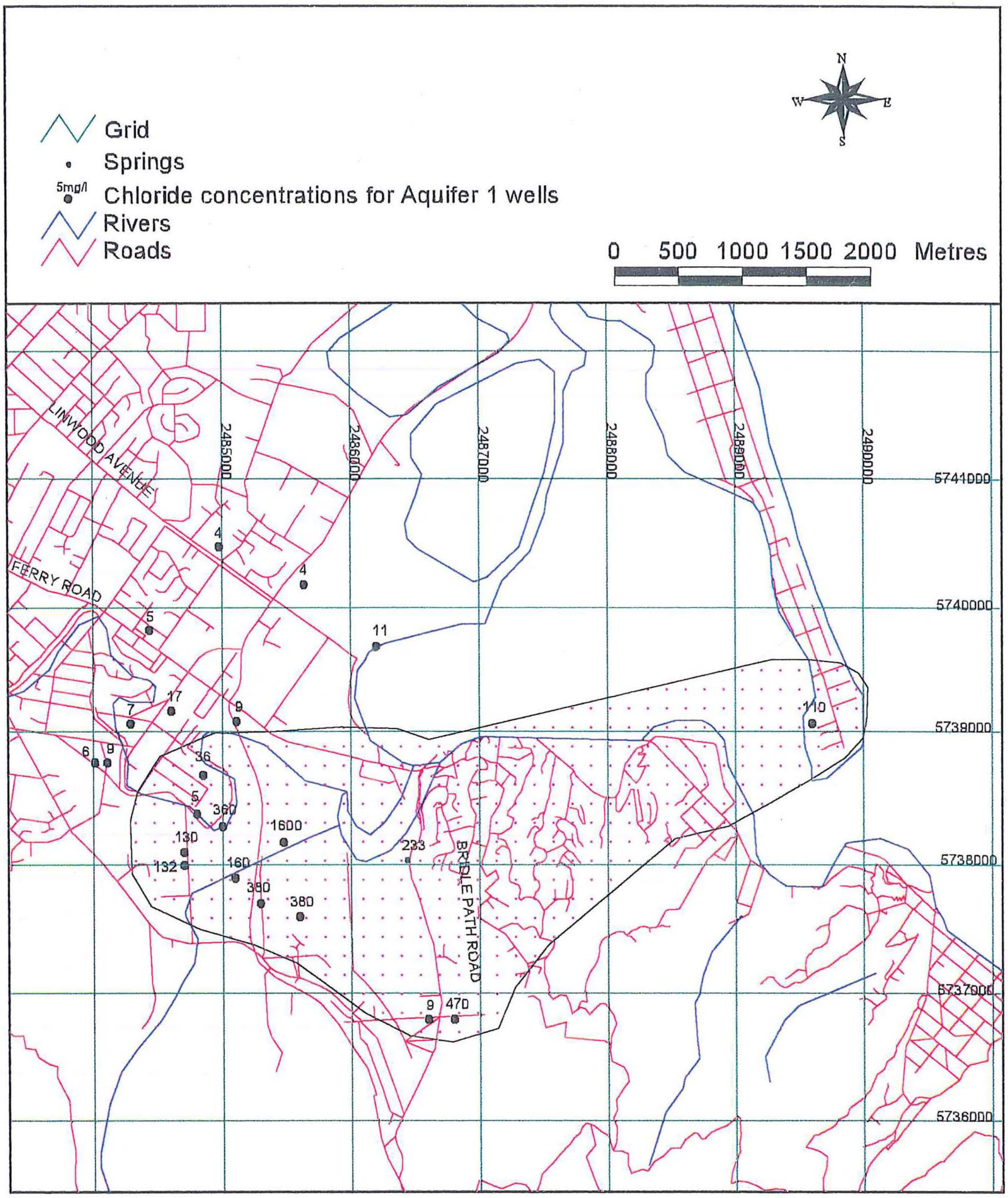


Figure 4.3 Chloride concentrations [mg/l] for groundwater from Aquifer 1 wells in the study area. The area in which groundwater exhibits anomalously high chloride concentrations is highlighted.

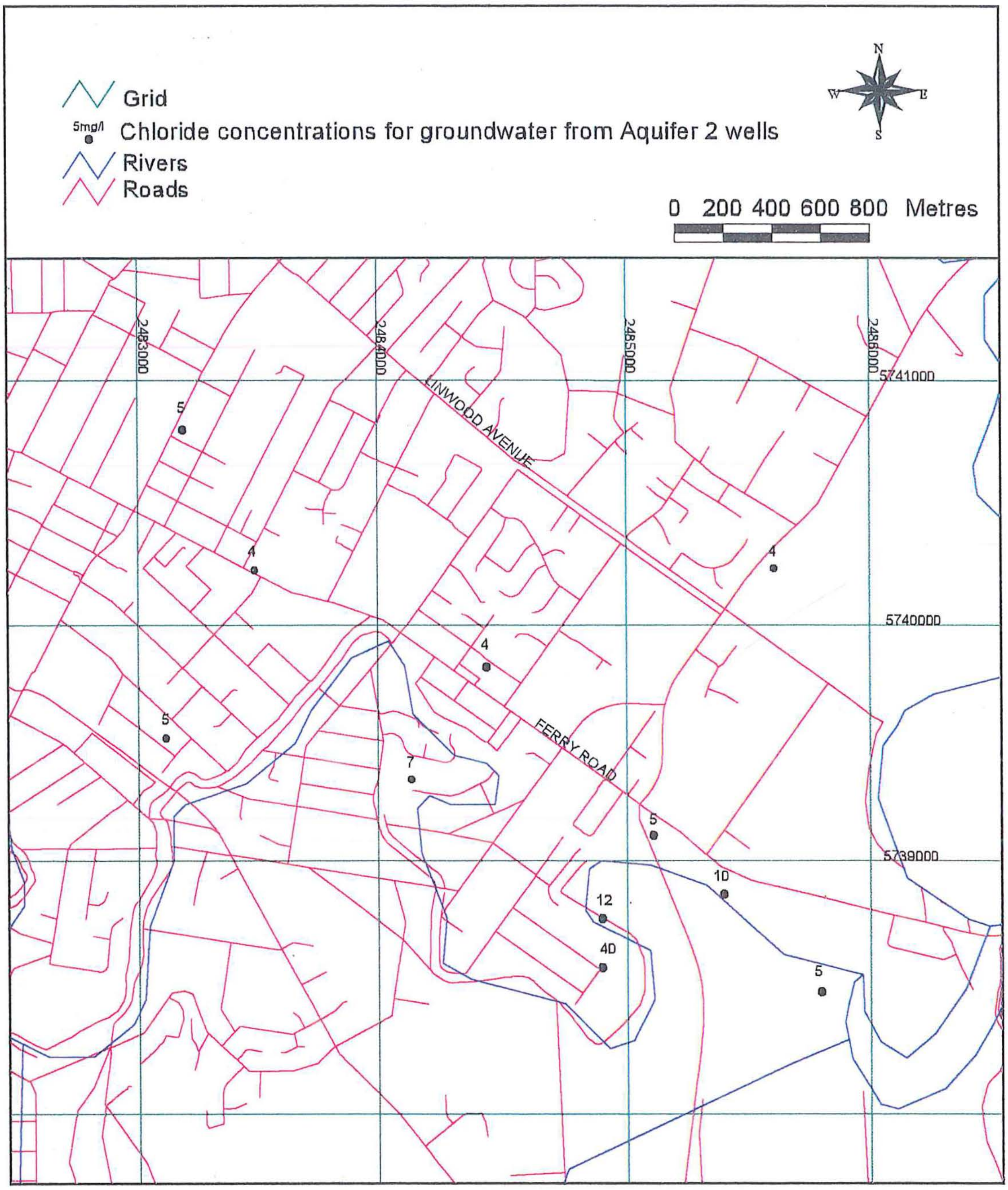


Figure 4.4 Chloride concentrations [mg/l] of groundwater from Aquifer 2 wells in the study area.

4.3 Potentiometric survey of the study area

4.3.1 General

Potentiometric contours represent lines of equal potentiometric or hydraulic head. The hydraulic head of a confined aquifer is equal to the mechanical energy per unit weight of the fluid and is defined as:

$$h = z + p/\rho g$$

where: z= elevation of the measuring point above datum

p= the pressure of a fluid

ρ= density of the fluid

g= gravity constant.

Since groundwater moves from higher potentiometric heads to lower potentiometric heads, a general flow direction perpendicular to the potentiometric contours can be indicated by a potentiometric surface.

4.3.2 Methods

Forty-two wells were surveyed in order to create a potentiometric contour map for Aquifer 1 and 2 within the study area. In a door to door survey, organised by staff from the Canterbury Regional Council, a network of 24 wells for Aquifer 1 and 17 wells for Aquifer 2 were located, access details recorded, and a potentiometric survey undertaken. The survey included some wells outside the actual study area in order to achieve a better spatial representation of groundwater head conditions. The potentiometric survey was conducted on the 2nd of March 1997 between 9am and 1pm. Standpipe piezometers were sufficient to measure the lower hydraulic heads of Aquifer 1 wells. A pressure gauge was used for the higher potentiometric heads of Aquifer 2 wells. In this study the datum reference is the 1937 Lyttelton mean sea level. Since then sea level has risen by about 0.26m. The measuring points were defined for each well and their elevations above datum were determined by theodolite. In order to lessen the error due to the tidal and groundwater abstraction effects over time, water level versus time graphs were used from three Aquifer 1 (M35/5400, M36/1159, M36/4730) and two Aquifer 2 (M35/5760, M36/4628) Canterbury Regional Council recorder wells (for well locations see Figure 4.5). Tidal effects dominated the coastal area at Dyers Road, whereas further inland the changes in water level over time resulted mainly from groundwater abstraction effects (see Appendix B.1). The head for each well used was recalculated at a reference time of 11^{00} hours New Zealand Standard Time (NZST). A spatial correction of water levels (e.g., the amplitude of the tide decreases landward) could not be applied due to an insufficient network of recorder wells. An interpolation of the water level versus time graphs of the two recorder wells M35/5400 (Bexley Road) and M36/1159 (Scruttons Road) was chosen in order to recalculate the approximate water levels at 11^{00} hours NZST for Aquifer 1 wells in between this area. An interpolation of the water level versus time graphs of the two recorder wells M36/1159 (Scruttons Road) and M36/4730 (Radley Park) was chosen in order to recalculate the approximate water levels of Aquifer 1 wells west of Scruttons Road. Water level versus time graphs of M35/5760 (Dyers Road) and M36/4628 (Radley Park) were used to recalculate the water levels at 11^{00} hours NZST for the wells occurring in the area mostly affected by tides and by water abstraction for Aquifer 2 respectively. The water level versus time graphs (between 6^{00} hours and 12^{00} hours NZST) of the recorder wells are shown in Appendix B.2.

Possible errors are:

- Varying water levels over space and time due to tides and water abstraction differences in the screen depth of the wells.
- Pumping of water from some wells in the area is likely to have occurred while the potentiometric survey was carried out.
- Isolation of wells from shallower/deeper wells connected to the same reticulation system
- Errors in measuring the height of the heads.
- Errors in measuring the height of the measuring points above sea level.
- Other human mistakes (such as mixing up wells and well numbers, etc).

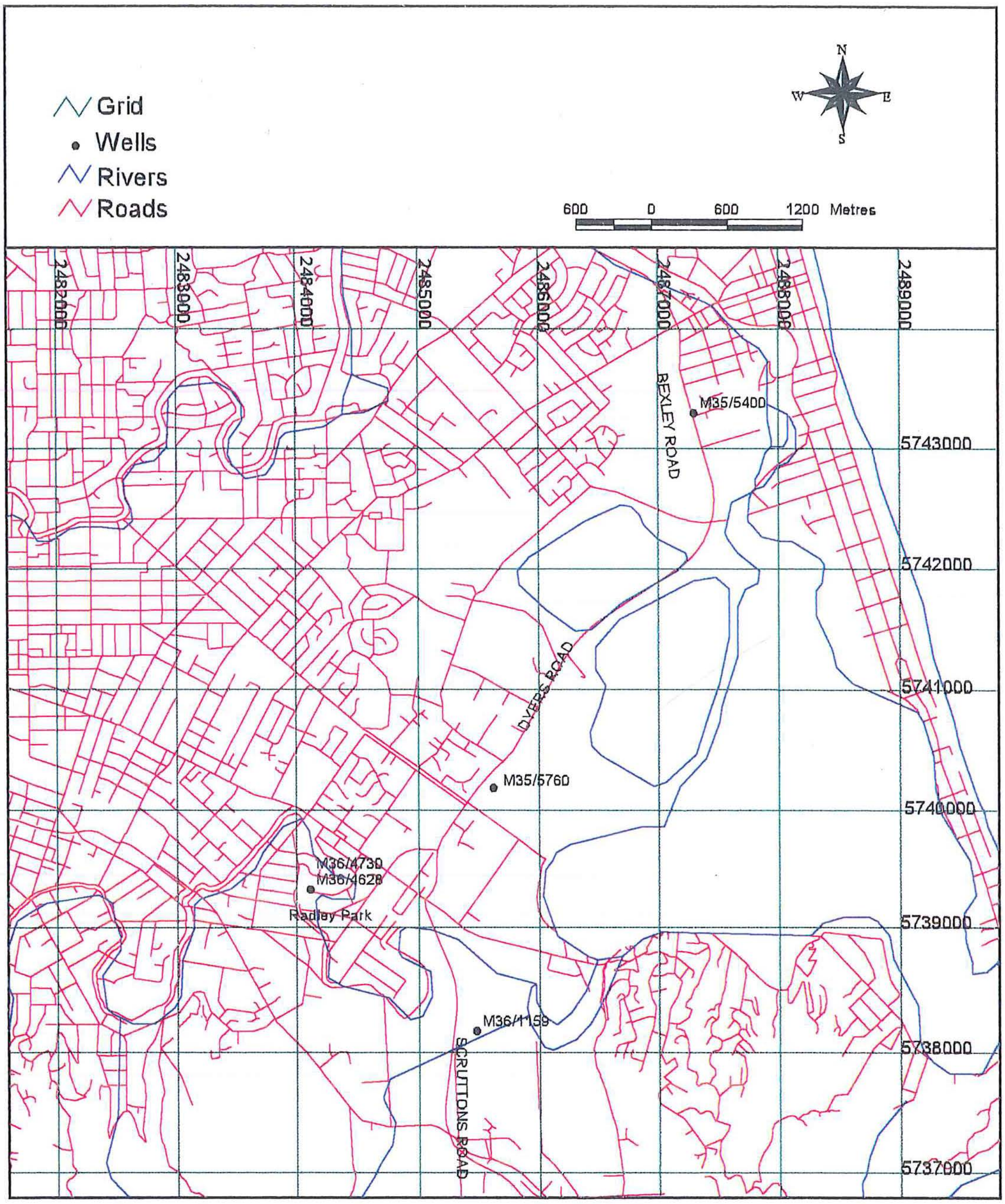


Figure 4.5 Locations of Canterbury Regional Council recorder wells whose water level versus time graphs were used to recalculate the water levels measured during the potentiometric survey to a reference time.

4.3.3 Potentiometric surfaces for the study area

The results of the potentiometric survey for Aquifer 1 and 2 are shown in Figure 4.6 and 4.7 respectively. The potentiometric surface map for Aquifer 1 shows sub-parallel and north-south orientated contour lines in the west. The 3.5m contour line bends around the estuary, indicating that groundwater flow is directed toward the estuary. An abnormal area of low pressure, where heads below mean sea level have been determined, coincides with a main pumping station owned by the Christchurch City Council for public water supply (well number: M36/1917) and a well owned by a local fish processing industry (Independent Fisheries; well number: M36/4906). The groundwater flows perpendicular to the contour lines and thus towards the area of low pressure. The potentiometric contour map suggests that the well M36/1159, which exhibits the highest chloride concentration in the area, would be the first well to be contaminated if seawater was to be drawn into Aquifer 1 from the estuary.

A similar pattern can be observed for the potentiometric surface map of Aquifer 2 (Figure 4.7). Potentiometric contour lines bend around the estuary, indicating groundwater flow toward the estuary. However, Aquifer 2 hydraulic heads are above sea level in Woolston and higher than Aquifer 1 hydraulic heads, showing that the hydraulic gradient between Aquifer 2 and 1 was directed upward at the time of the survey.

The data obtained from the potentiometric survey is shown in more detail in Appendix B.3.

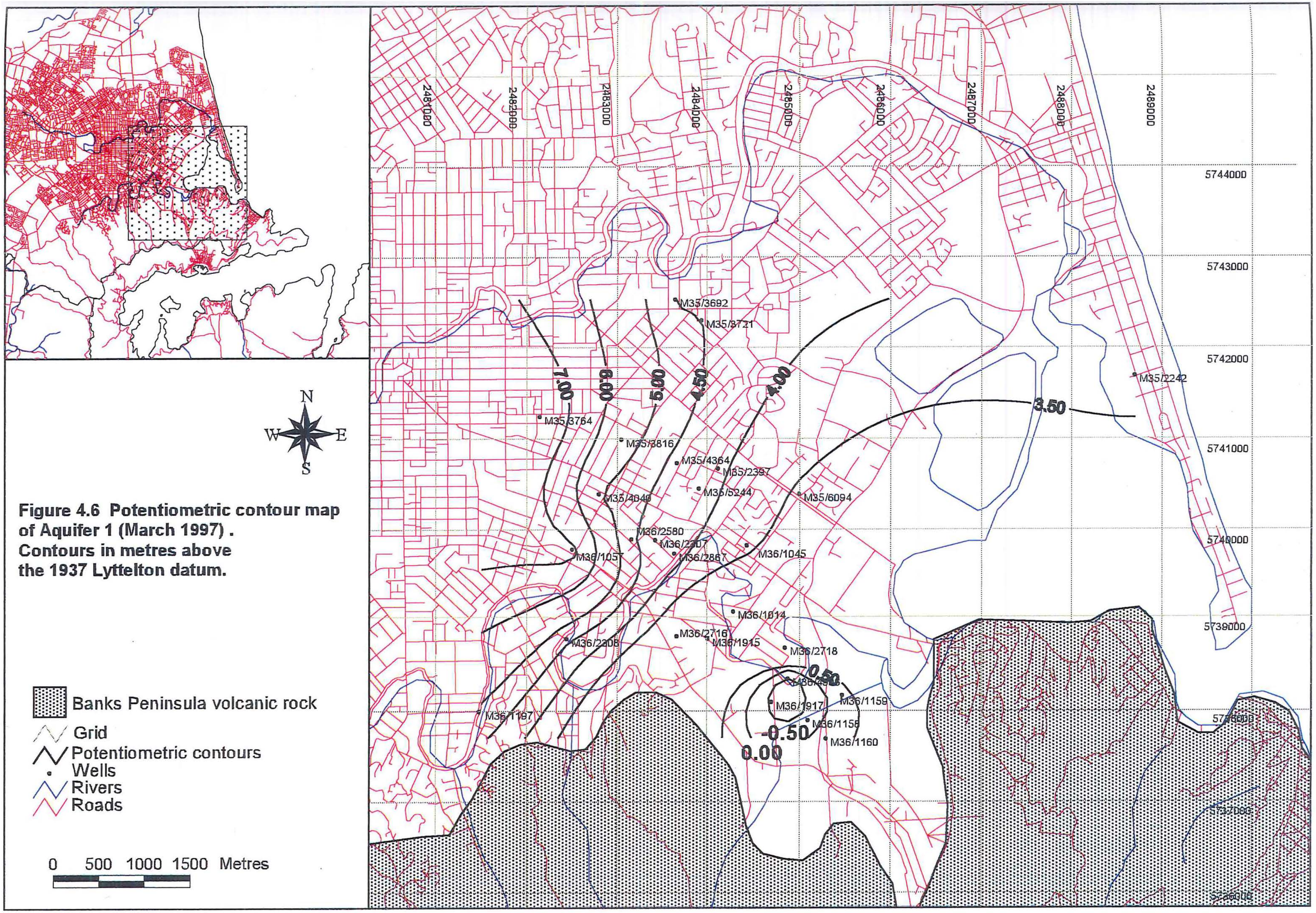


Figure 4.6 Potentiometric contour map of Aquifer 1 (March 1997). Contours in metres above the 1937 Lyttelton datum.

Figure 4.7 Potentiometric contour map of Aquifer 2 (March 1997). Contours in metres above the Lyttelton 1937 datum.

4.4 Relationship between groundwater chemistry and potentiometric heads.

To examine whether the poor groundwater quality and the low potentiometric heads in the study area are related, groundwater samples were collected. The wells were pumped until two to three times the volume of water standing in the well casing was discharged. Bottles, which were used to collect inorganic determinands, were rinsed three times with the water being sampled. The samples were analysed by Standard Telarc-accredited analytical methods. Two Aquifer 2 wells, one inside and one outside the area of low potentiometric pressure, and four Aquifer 1 wells, three inside and one outside the area of low potentiometric pressure, were sampled and analysed for simple quality indicators: conductivity and chloride concentration. Samples were collected at each site once a week over a period of 5 weeks to assess how variable the quality characteristics were. The results for conductivity and chloride concentration are shown in Table 4.1. The well locations are displayed in Figure 4.8. Groundwater quality was reasonably stable at all the sites over the sampling period. It is obvious that the samples taken within the area of low pressure have distinctly higher chloride contents and higher conductivities than the samples from outside the area of low pressure for both aquifers. This suggests that the low potentiometric heads, caused by high rates of groundwater abstraction in the study area are a major reason for the poor groundwater quality. Groundwater from Aquifer 2 wells inside the area of low potentiometric pressure exhibits smaller chloride concentrations and conductivities than groundwater from the Aquifer 1 wells inside the area of low potentiometric pressure. However as indicated previously no Aquifer 2 wells exist in the area where Aquifer 1 wells show the greatest extend of groundwater contamination. It is therefore impossible to determine which of the two aquifers is contaminated to a greater extent. The conductivity of a groundwater sample taken at the 14/05/97 from the well M36/4595 is likely to have been mistaken with the result from the well M36/1072.

		Aquifer 1				Aquifer 2	
		inside low pressure area			outside	inside	outside
date	well no:	M36/1159	M36/2591	M36/1072	M36/0979	M36/4595	M35/3789
21/04/97	Cl [g/m^3]	1600	400	330	9	23	5
30/04/97	Cl [g/m^3]	1600	380	330	7	22	4
9/05/97	Cl [g/m^3]	1700	230	320	5	21	4
14/05/97	Cl [g/m^3]	1700	360	310	8	23	4
21/05/97	Cl [g/m^3]	1700	360	310	5	21	4

date	well no:	M36/1159	M36/2591	M36/1072	M36/0979	M36/4595	M35/3789
21/04/97	CON [mS/m]	510	170	130	19	22	13
30/04/97	CON [mS/m]	520	160	130	15	22	12
9/05/97	CON [mS/m]	510	120	130	14	?130	12
14/05/97	CON [mS/m]	520	160	130	19	23	12
21/05/97	CON [mS/m]	520	160	130	15	21	12

Table 4.1 Values for chloride concentration and conductivity are displayed for Aquifer 1 and 2 wells inside and outside the area of low potentiometric heads.

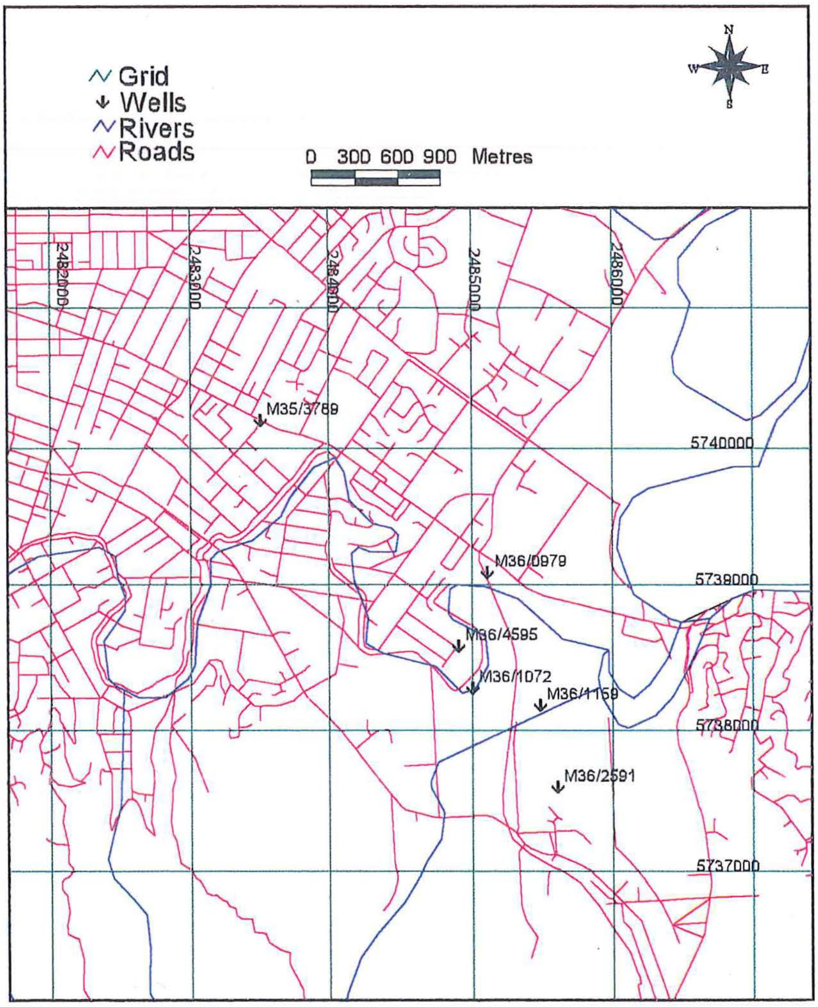


Figure 4.8 Location of wells sampled for chloride concentration and conductivity inside and outside the area of low potentiometric heads.

4.5 Potential saline contaminant sources and their relevance to groundwater contamination in the study area

4.5.1 General

Sources of groundwater contamination associated with an increasing salinity have been divided into surface and non-surface sources (AKTINSON *et al.*, 1986):

1) **surface sources:**

a) oil field brine pits
b) road de-icing salt
c) irrigation
d) contamination from underlying evaporites
e) waste leachate from landfills or contaminated sites

2) **non-surface sources:**

a) seawater intrusion due to over pumping in coastal and tidal areas
b) leaky well casings which can promote the mixing of water of different chemical characteristics from different depths within an aquifer, or between aquifers
c) contamination from thermal waters
d) contamination from connate seawater

4.5.2 Oil field brine pits

Groundwater contamination in areas of intense petroleum exploration and development can be caused by the disposal of waste brine through injection and/or from the discharge of saline water from abandoned oil and gas wells. Several petroleum exploration bores have been drilled in and around Christchurch but all have been unsuccessful. Oil field brine pits do not exist in this setting and can therefore be excluded as a possible contaminant source.

4.5.3 Road de-icing salt

Where road de-icing is needed in winter, sand or gravel is spread over the roads in parts of Christchurch. Salts, including sodium chloride, are not used for this purpose so can ~~be neglected as a possible source of groundwater contamination in the area.~~

4.5.4 Irrigation

In irrigated areas approximately 50-75% of the applied water evaporates leading to an increased salt concentration of the remainder. Also the addition of salts by dissolution during the irrigation process and from salts added as fertilisers or soil amendments may contribute to the degradation of the applied water (TODD, 1980). The degraded water may contaminate groundwater. Some horticulture is spread around Bridle Path Road in the Heathcote Valley (see Figure 4.3). However, irrigation there is limited by the poor quality of water available for this use. In general irrigation in the area of interest is mainly restricted to residents watering small household gardens. The climate is not conducive to the accumulation of salts or evaporites in the soil, nor of their flushing into the subsurface. In addition soil types are heavy with low permeabilities. Therefore the physical setting, the climate, and landuse, mean that irrigation is an unlikely contaminant source of groundwater in the Woolston/Heathcote area.

4.5.5 Contamination from evaporites

Marine evaporites derive from the precipitation of chemicals, which are super-saturated in solution. Common geological settings are sabkhas in the supratidal region, where saline water precipitates salt in the pores of the sediments, and enclosed basins, which are separated from the sea by a physical barrier and therefore experience restricted circulation with the open sea (LEWIS and MCCONCHIE, 1994). While the Woolston/Heathcote area may have been physically separated from the sea during sediment accumulation around the base of the Banks Peninsula volcanics the past climate conditions were not conducive to evaporite production. In addition if evaporites were a source of groundwater contamination in the study area it would be expected that the contamination would increase with the pumping rate of the wells as the saline water would be drawn from overlying and underlying formations. However, this trend has not been observed. The well established geological stratigraphy of the area indicates that evaporites are not present at depth.

4.5.6 Contamination from landfill leachate and/or contaminated sites

For most parts of Christchurch the risk of groundwater contamination by downward movement of landfill leachate or other surface contaminants is regarded as relatively low due to the presence of a thick upper confining layer (up to 40m of dominantly sand, silt, and clay) and because leakage of groundwater is directed upwards following the hydraulic gradient. However, large rates of abstraction can reverse the hydraulic gradient directing leakage and any associated contaminants vertically downward into deeper aquifers. Since Aquifer 1 water levels in the study area are very low and old landfills and other contaminated sites are present in the study area, this condition might occur.

4.5.7 Seawater intrusion

In the Woolston/Heathcote area potentiometric levels have been drawn below sea level, implying that the potential risk of seawater intrusion is increased. The freshwater/seawater interface could be drawn inland, upconing of seawater into pumping wells could occur, or seawater from the estuary could leach down from the surface into the aquifers. Additionally preferential flow paths in the confining layer, which develop due to the compression of the aquifer as a result of groundwater abstraction, could promote leakage.

4.5.8 Leaky well casings

Leaky well casings can act as a pathway for the mixing of water sources at different depths potentially within an aquifer or between aquifers. Saline water introduced or found within surface or subsurface sediments could migrate into different aquifer levels via travel along or through a well casing. Many of the wells in the Woolston/Heathcote area were drilled many years ago and their structural integrity is unknown (SMITH, 1998, *pers.comm.*).

4.5.9 Thermal groundwater

Thermal groundwaters which are believed to be related to Banks Peninsula volcanism have been detected in and around Christchurch (COLLINS, 1953). Thermal groundwater from wells and springs, related to volcanism derives from the circulation of groundwater to the old magma chamber where the water is heated and rises up along faults, joints or fissures (SKINNER *et al.*, 1987). A detailed description of the thermal waters is given in COLLINS (1953) and in BROWN and WEEBER (1994). In the study area the only known thermal well or spring is Ferrymead spring in the Heathcote Valley (spring no: M36/3677). It was formerly used to grow hot house tomatoes. Other warm springs were thought to occur further downstream from the Ferrymead spring on the riverbank. North-east of the Ferrymead spring opposite the foot of the road up Mount Pleasant, a small warm spring was reported to flow onto the mudflats of the Avon and Heathcote Estuary (COLLINS, 1953). Figure 4.9 shows a Piper diagram of groundwater from thermal wells in and around Christchurch, from the different aquifers under Christchurch, and from the Heathcote Valley. Ambient Christchurch groundwater samples plot as being bicarbonate and calcium dominated, whereas the Aquifer 1 Heathcote groundwater samples plot as chloride and sodium type dominated. Groundwater from wells intersecting volcanic rock, and springs flowing from volcanic rock plot over a wide area between these two end members. Based on the Piper diagram it could be suggested that the Heathcote Valley groundwater might be derived from mixing of natural Christchurch groundwater and water from thermal wells which are influenced by the chemistry of the volcanic rock through which the water flows (WEEBER, 1993). Seawater is also plotted on Figure 4.9 and could just as well account for the Heathcote Valley groundwater chemistry if mixed with ambient Christchurch groundwater.

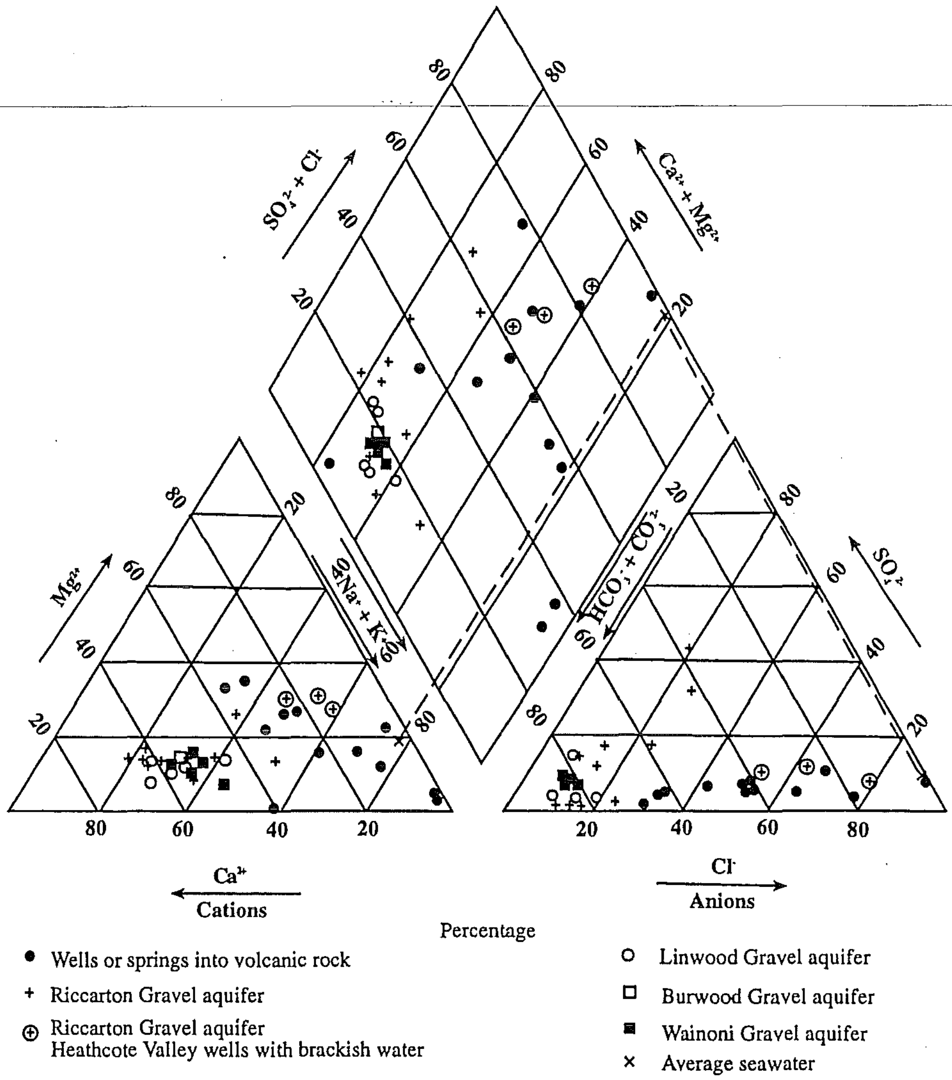


Figure 4.9 Piper trilinear diagram showing chemical analyses for water samples from thermal and mineral springs and wells adjacent to Banks Peninsula, and confined gravel aquifer wells underlying Christchurch. (redrawn from WEEBER, 1993).

A location map of so-called thermal wells near the study area is shown in Figure 4.10. Table 4.2 shows chemical data of groundwater from these wells compared with chemical data of groundwater from wells within the Heathcote Valley. Focusing on the chloride content indicates that the high chloride values of the groundwater in parts of the Heathcote Valley could not be achieved by mixing between ambient Christchurch groundwater and water from thermal wells and springs. Chloride concentrations of the water from thermal wells and springs are below chloride concentrations of the groundwater, abstracted from some wells in the Heathcote Valley. This is also the case for other thermal wells around Banks Peninsula, which were identified by BROWN and WEEBER (1994). The chemical data of Ferrymead spring (spring number: M36/3677), which was published in BROWN and WEEBER (1994), showed a chloride concentration of 4704 mg/l. This sample exhibited far higher major ion concentrations than any other samples taken from the well before and after that sample occasion (1987). This anomaly could have arisen by seawater being sucked into the shallow well from the estuary, as it was pumped to allow it to be sampled. This would indicate a good hydraulic connection between the estuary and Ferrymead spring, which may exhibit high ionic loading because it is affected by seawater intrusion, not because it is a thermal well. Chemical data from other "thermal wells", e.g., Yellowstone hot spring, are noted in Table 4.3. These are active geothermal systems with very different waters both in chemistry and temperature form "thermal" springs and wells found around Banks Peninsula.

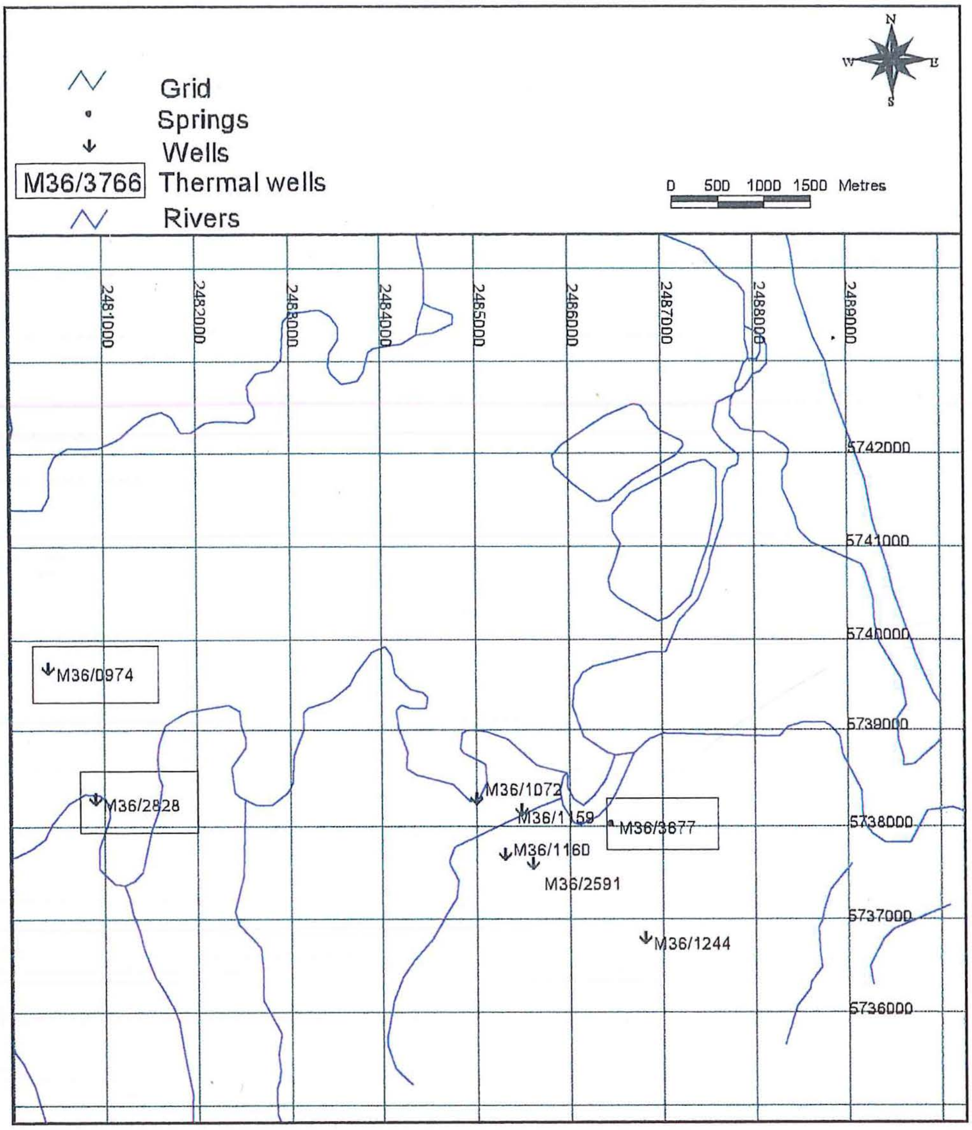


Figure 4.10 Location map of thermal wells and wells yielding contaminated groundwater in and near the study area.

	WELL NO	SAMPLING DATE	HCO_3 g/m³	CL g/m³	SO_4 g/m³	NA g/m³	K g/m³	MG g/m³	CA g/m³
Thermal water	M36/3677	29/03/95	134	232.9	22.3	153.1	5.6	13.7	32.1
	M36/2828	17/11/93	39	8.1	12	11	1.5	1	14.6
	M36/0974	17/11/94	115	23	41	18	1.8	7.8	46
Heathcote Valley water	M36/1072	12/05/94	140	360	56	164	4.2	27.3	84
	M36/1159	8/02/95	64	1700	230	360	10	230	210
	M36/1160	11/05/94	204	380	92	160	17	79	56
	M36/1244	11/05/94	214	470	130	335	1.7	39	48
	M36/2591	7/02/95	220	370	90	710	34	56	80

Table 4.2 Major ion concentrations of Heathcote Valley water and thermal water from the wells, shown on the location map above, suggest that thermal water alone is unlikely to be the only contaminant source.

Location	**Temperature**	**Chloride concentration**	**Reference**
Yellowstone hot spring, Wyoming, USA	94°C	405mg/l	(MAIDMENT, 1993)
Washoe County, Nevada, USA	186°C	874mg/l	(MAIDMENT, 1993)
Hanmer geothermal spring, New Zealand		1 to 700mg/l	(MOORE, 1993)
Kawerau hotspring in Taupo, New Zealand		386mg/l	(LIPING, 1994)
Kawerau geothermal borewater in Taupo, New Zealand		810mg/l	(LIPING, 1994)

Table 4.3 Temperatures and chloride concentrations for thermal wells and springs.

The reported maximum concentration of 1700mg/l chloride in the Heathcote groundwater seems very high when compared to the above data and its measured temperature at 14°C is also inconsistent with thermal origin. It is also questionable whether some of the wells in and around Christchurch, which are quoted as "thermal" but exhibit relatively low temperatures (13-18°C) should be defined as such. Ambient groundwater in the Canterbury Plains tends to have temperatures in the order of 11-12°C. COWAN (1987) indicates temperatures of 11.3°C to 14.2°C for groundwater from depths between 6m and 30m below ground surface. However groundwater from shallow wells have periodically exhibited higher temperatures due to heat from pumps, up to 18.6°C quoted is one case in COWAN (1987). It is probable that the higher temperature from the Ferrymead spring quoted in BROWN and WEEBER (1994) reflects an incursion of estuarine water into the well (SMITH, *pers. comm.,* 1997). A reason for the higher groundwater temperatures within some wells that intersect volcanic rock relative to those that intersect the gravel strata of the Christchurch artesian aquifer system could be related to the physical properties of the rocks.

The thermal conductivity of rock is defined as follows (MATTHESS, 1982):

$$q = -\lambda \frac{d\delta}{dx}$$

where: $\frac{d\delta}{dx}$ = temperature gradient [Kelvin/cm]

q= heat flow [W/m^2]

The thermal conductivity of dry basalt has a value of about 2.18 W/m K whereas it is only 0.33-0.38 W/m K for dry sand (Table 61 in MATTHESS, 1982). Consequently it is likely that the thermal conductivity of the volcanic Banks Peninsula rock is higher than of the gravel strata of the Christchurch artesian aquifers. According to MATTHESS, (1982) differences in thermal conductivities of host rock can cause variations in fluid temperature. Since the thermal conductivity of water is low and only limited mixing occurs at low flow velocities, different zones of temperature can exist between adjacent groundwater bodies laterally as well as vertically.

4.5.10 Connate seawater

Connate water is trapped within the voids of the rock mass during its deposition and can be a source of water salinity if not flushed from the rock afterwards. WEEBER (1993) proposed that connate water within Bromley and/or Christchurch Formation could be a potential contaminant source of the Riccarton Aquifer. However, the argument of an upward hydraulic gradient, and groundwater leakage from lower to shallower aquifers (TALBOT *et al.*, 1986) suggests that such connate seawater would be flushed out of the system. Additionally it would be expected that wells used under very high abstraction rates would suck connate seawater from the formations overlying and underlying the well screen. The degree of groundwater pollution would be expected to increase with increased pumping rates until connate water was replaced by ambient groundwater. In Woolston/Heathcote this is not the case. Instead groundwater from well M36/1159 which is not pumped at all, but is the well closest to the estuary, contains the highest concentrations of ions. This leads to the assumption that the contaminant source is situated to the east rather than to the top or bottom of the aquifer. Another possibility outlined by WEEBER (1993) is that the groundwater quality is affected by connate seawater trapped within the voids of volcanic rock, which occurs as a sea stack underneath the area (see Section 3.4). The seawater would be released as the rock alters. However, the same principle applies here. The contoured sea stack is located to the west of the contaminated wells however, as mentioned earlier, it is more likely that the contaminant source comes from the east.

4.6 Groundwater contamination by seawater intrusion

4.6.1 General

Potential saline sources of groundwater contamination have been examined in the Woolston/Heathcote area. For various reasons that have been outlined earlier most saline sources except for seawater intrusion, landfill leachate, and leaky well casings could be excluded as likely contaminant sources in the study area. The focus of this investigation therefore moves to examine these three potential contaminant sources in greater detail.

4.6.2 A conceptual model of groundwater contamination by seawater intrusion

Seawater intrusion due to over pumping is common in coastal aquifers. The problem has been encountered in very populated and/or dry coastal regions in England, the Netherlands, Germany, Israel, Japan, Hawaii, USA, and elsewhere. Seawater may contaminate a coastal aquifer system by onshore leakage from brackish sources, for example the estuary and sloughs, the landward shifting of the freshwater/seawater interface due to pumpage as indicated on Figure 4.11, or by upconing of underlying seawater into a pumping well (Figure 4.12).

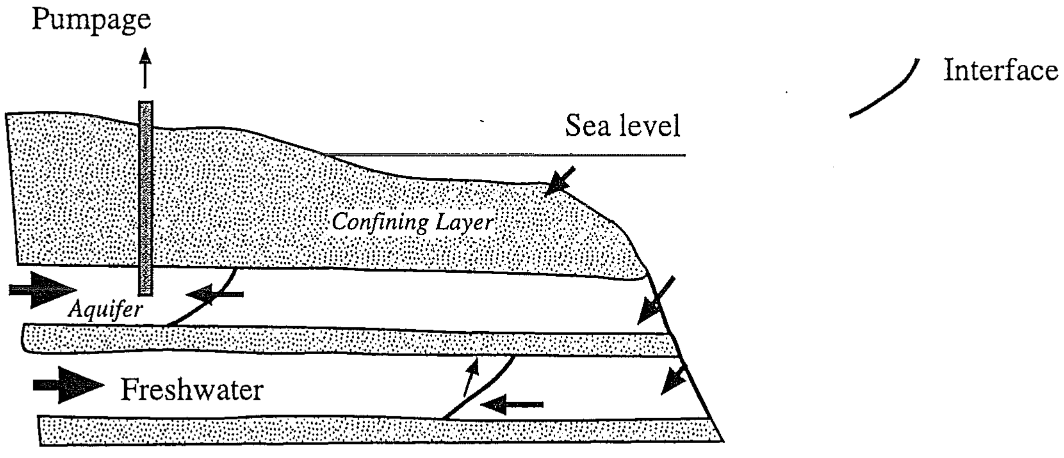


Figure 4.11 Landward shifting of the freshwater/seawater interface due to onshore development.

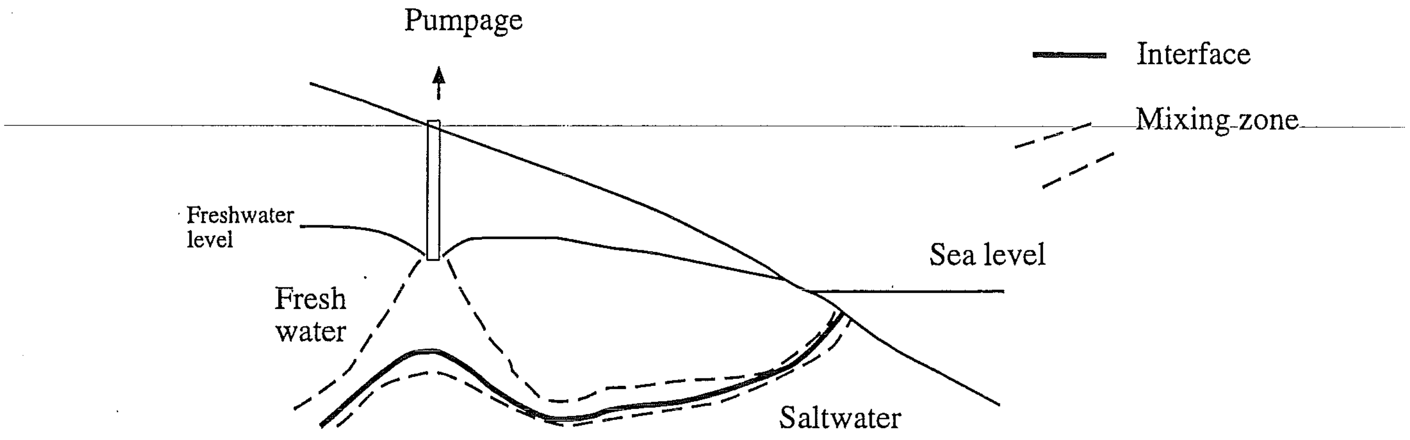


Figure 4.12 Upconing of underlying saltwater into a pumping well (redrawn from CUSTUDIO, 1987).

Since the risk of seawater intrusion for the Christchurch aquifer system has been underrated in the past, a modelling approach has been initiated in this study to enhance the understanding of the freshwater/seawater interface along the coast of Christchurch. For more detail readers are referred to Chapter 5.

In the Heathcote Valley it is unlikely that groundwater contamination results from a landward shifted freshwater/seawater interface for two reasons:

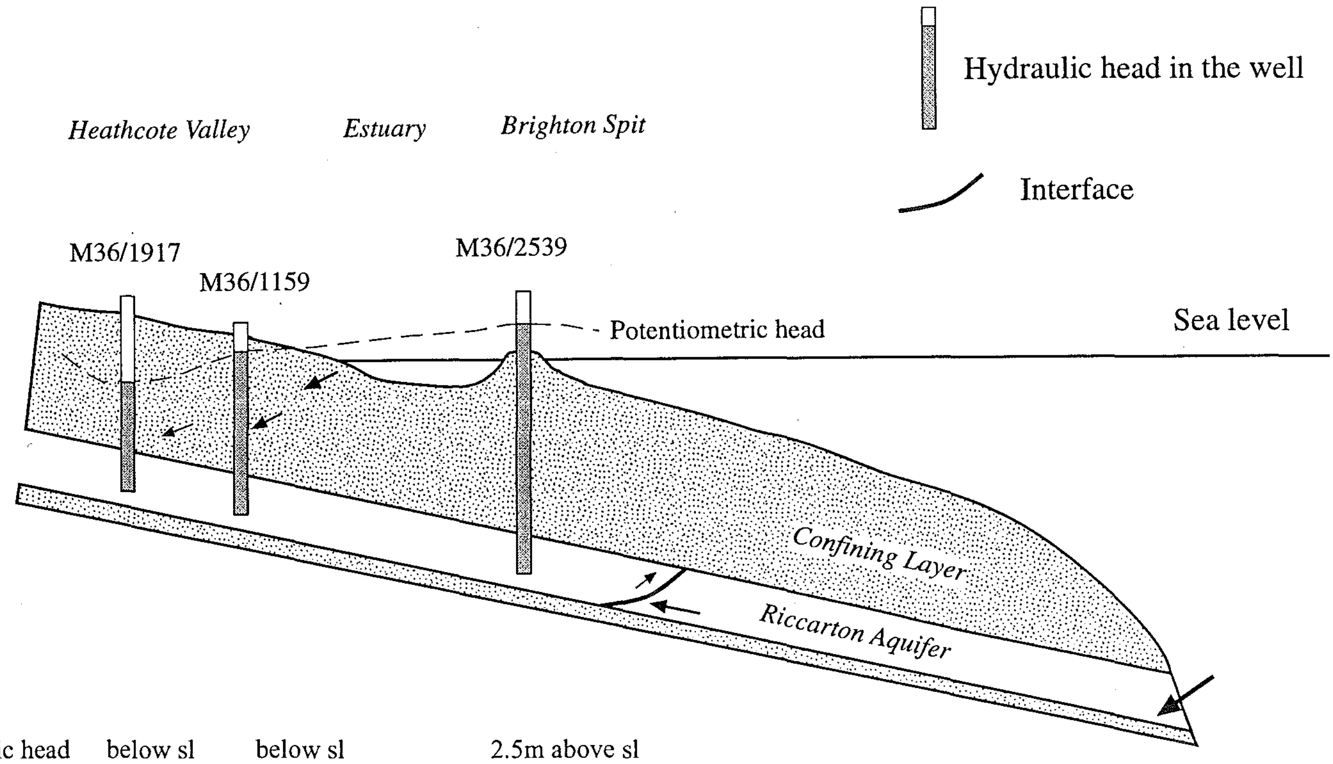
1. In Christchurch the Riccarton Aquifer reaches a depth of approximately 50m along the coast. According to the Ghyben-Herzberg relationship (see Section 5.2) hydraulic heads of at least 1.25m along the shoreline should keep the interface offshore. The well which exhibits the lowest mean hydraulic head of 2.5m along the coast of Christchurch (located at South New Brighton Spit, well number: M36/2539) had a minimum water level of 2.04m in the past, which seems too high to allow the freshwater/seawater interface to move onshore.

2. A landward shift of the freshwater/seawater interface would give rise to much higher chloride concentrations in groundwater from wells along South New Brighton Spit compared to groundwater from the more inland positioned wells. In fact, the reverse applies with well M36/2539 which is 50m deep and exhibits chloride concentrations of 110mg/l (sampling date 17/06/97) and well M36/1159 in the Heathcote Valley which is only 30m deep and has chloride concentrations of 1600mg/l (sampling date 11/06/97) (see Figure 4.13).

The next possibility of seawater intrusion is upconing of water into a pumping well. In the Heathcote Valley this can be ruled out for two reasons:

1. As shown above the freshwater/seawater interface is likely to not have shifted landward yet so that no underlying saltwater is expected in the study area.
2. A main pumping well in Chapmans road (well no.: M36/1917) is far less contaminated than a well on Scruttons road (well no.: M36/1159), which is not pumped at all.

Another possibility of saline intrusion is downward leakage of saltwater from the estuary. This is the most plausible mechanism of saline intrusion for the study area, because water levels have been drawn below sea level in the Heathcote Valley resulting in a downward gradient between the estuary and Aquifer 1. Figure 4.13 illustrates a conceptual model of groundwater contamination in the study area by downward leakage of estuarine water based on the available information on hydraulic heads and chloride concentrations of two wells in the Heathcote Valley and one well at the shoreline.



Approx. hydraulic head	below sl	below sl	2.5m above sl
Approx. Cl⁻ concentration	240mg/l	1600mg/l	110mg/l
Well depth	33.4m	33.8m	49.16m

Figure 4.13 Conceptual model of groundwater contamination in the study area by estuarine water leaching down to Aquifer 1 following the downward gradient between the two.

In a modelling study on seawater intrusion in a poorly-confined, stratified coastal aquifer system BOND and BREDEHOEFT (1987) concluded that generally vertical leakage of overlying seawater is the dominant initial cause of seawater intrusion. They suggest that a significant time elapses before seawater inflow from the aquifer outcrop contaminates the aquifer system onshore. This mechanism of seawater intrusion has the most adverse environmental effects and should be prevented.

4.6.3 Chemical evidence of contamination from seawater

Figures 4.14a-d illustrate concentrations of various major ions plotted versus chloride concentrations for groundwater samples from a number of wells (M36/1072, M36/1158, M36/1159, M36/1160, M36/1163, M36/1187, M36/1244, M36/2591, M36/3677, M36/1917, M36/2539) in the study area. All the available data from each well has been used (see Appendix A.2). The best fit line and a seawater mixing path are displayed on each plot. If a simple mixing of groundwater with seawater was occurring the best fit line and the seawater mixing path would be expected to show a similar trend. However, when the graphs are analysed it is important to consider that the following processes could affect the mixing pattern:

- Precipitation
- Dissolution
- Ion exchange

For example in Figure 4.14a the sodium versus chloride best fit trend indicates that the groundwater is depleted in sodium relative to the seawater mixing path whereas on Figure 4.14b calcium is enriched relative to the seawater mixing path. This occurs commonly and is caused by ion exchange due to an excess in sodium (HOWARD and MULLINGS, 1996):

$$2Na^{+} + Ca_{(adsorbed)} \rightarrow 2Na_{(adsorbed)} + Ca^{2+}$$

Sodium is absorbed into the clay minerals when saturated with seawater whereas calcium is released. On Figure 4.14c the trend in sulfate concentrations matches the seawater mixing path closely. The chloride to bicarbonate ratio is a very useful tool to evaluate seawater intrusion (REVELLE, 1941, cited in TODD, 1980). Chloride is the dominant ion in seawater, but has low concentrations in groundwater whereas the pattern for bicarbonate is the reverse having high concentrations in groundwater and low concentrations in seawater. Chloride is generally chemically inert and its concentration is not subject to changes by precipitation, ion exchange, and dissolution, if waters of different chemistries are mixed. Figure 4.14d displays the chloride to bicarbonate ratios. A linear best fit trend does not describe the data well. Points cluster in a group with low chloride content while at higher chloride values, bicarbonate concentrations are consistently around 1.2mole/m^3. In Figure 4.15 the graph is shown with more detail. The well numbers are displayed. Contrary to the grouping of data for most wells M36/1159 shows a distinctive trend, which fits the seawater mixing path closely. It is generally directed toward a decreasing chloride versus bicarbonate ratio with time. This trend is a good indication that groundwater from the well M36/1159 is dominantly contaminated by seawater. Since 1994 the data show no increase in chloride concentration indicating that the situation may have stabilised. However, it is to be expected that in a dry year during water demand peak times water levels will drop further drawing more seawater in. The high concentrations of bicarbonate in groundwater from some other wells, for example M36/2591 could indicate that another contaminant source might affect the groundwater quality of those sites. Generally, increased bicarbonate content is typical for shallow groundwater recharged by precipitation, which seeps down from the surface absorbing carbon dioxide from the root zone in the soil. The bicarbonate concentration is also typically increased in groundwater affected by landfill leachate. In Figure 4.2b and Figure 4.2d groundwater from the well M36/2591 shows a very similar trend in chloride and bicarbonate concentrations at similar times. If this well were dominantly contaminated by seawater the converse would be expected showing relatively small bicarbonate concentrations when chloride concentrations are high. Therefore it is suspected that the well may be affected by another contaminant source such as landfill leachate.

Seawater intrusion is often revealed in water samples by the bromide to chloride ratio, since both ions are relatively inert to ion exchange, precipitation and dissolution. ANDREASEN AND FLECK (1997) have shown that the distinctive bromide to chloride ratio in seawater can be used to distinguish groundwater contamination from seawater intrusion from anthropogenic contaminant sources. Figure 4.16 illustrates the bromide to chloride ratio of the contaminated wells in the study area and the ratio, which is typical for seawater. Groundwater from those wells, which plot on the seawater ratio, is very likely to be dominantly affected by seawater intrusion. Groundwater from wells, which is unlike the seawater ratio, is possibly affected by anthropogenic sources or, likelier, by a mixture of seawater and anthropogenic sources. It can be concluded that trends in hydrochemical data obtained from groundwater within the study area strongly indicate that seawater acts as a major contaminant source. However, anthrophogenic derived sources are also suspected to affect the groundwater quality of some wells.

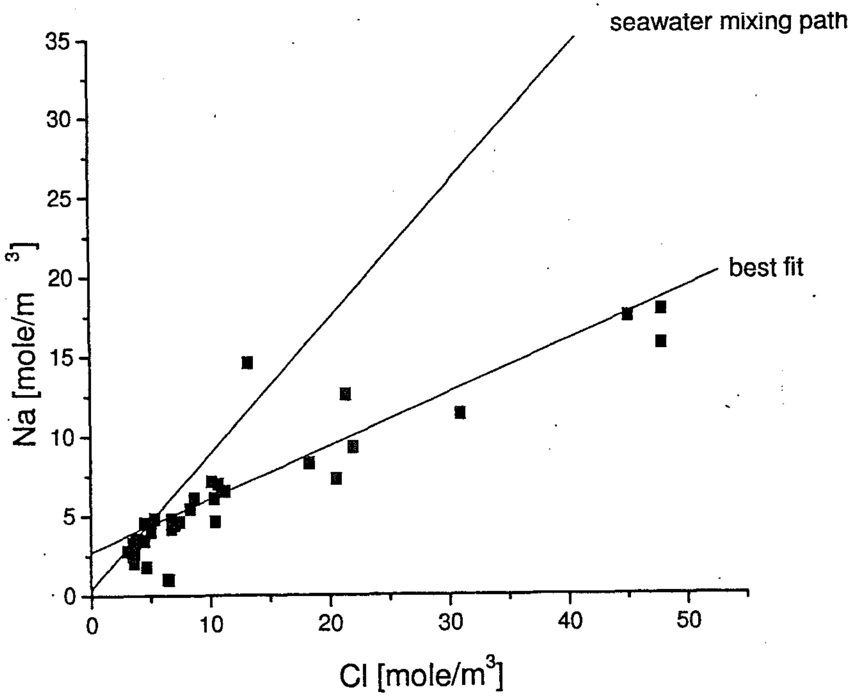


Figure 4.14a Plot of sodium versus chloride for contaminated Heathcote Valley water.

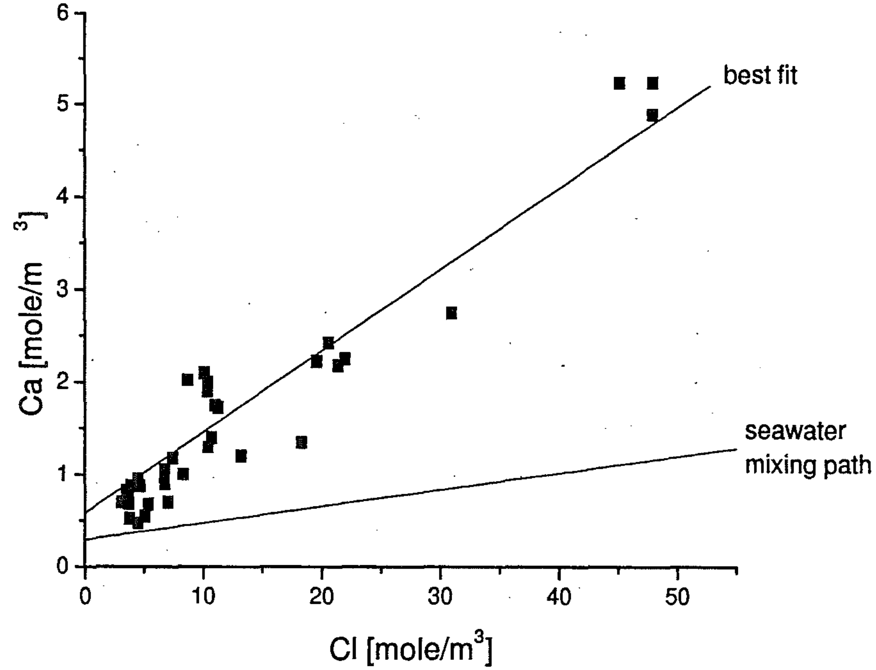


Figure 4.14a Plot of calcium versus chloride for contaminated Heathcote Valley water.

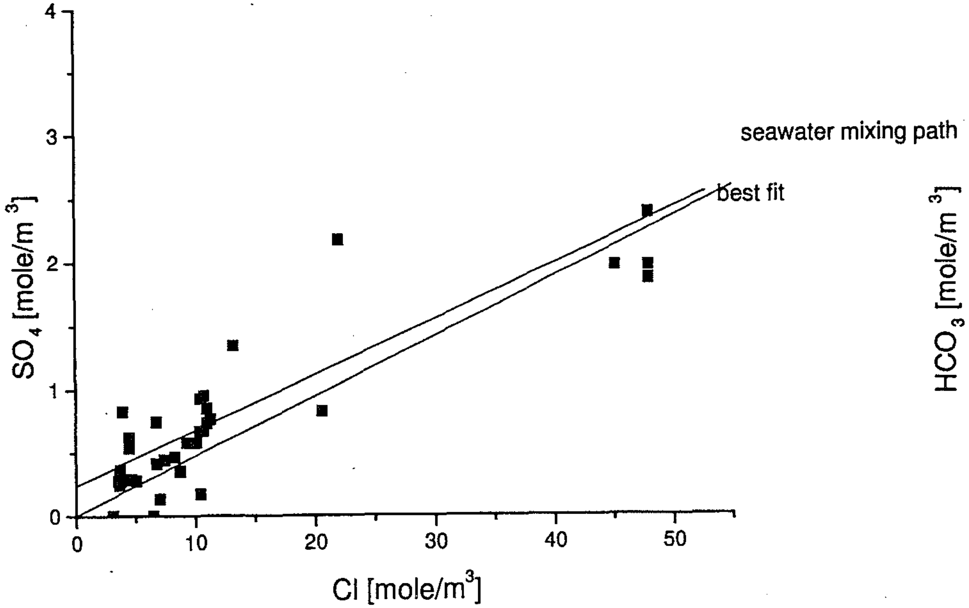


Figure 4.14c Plot of sulfate versus chloride for contaminated Heathcote Valley water.

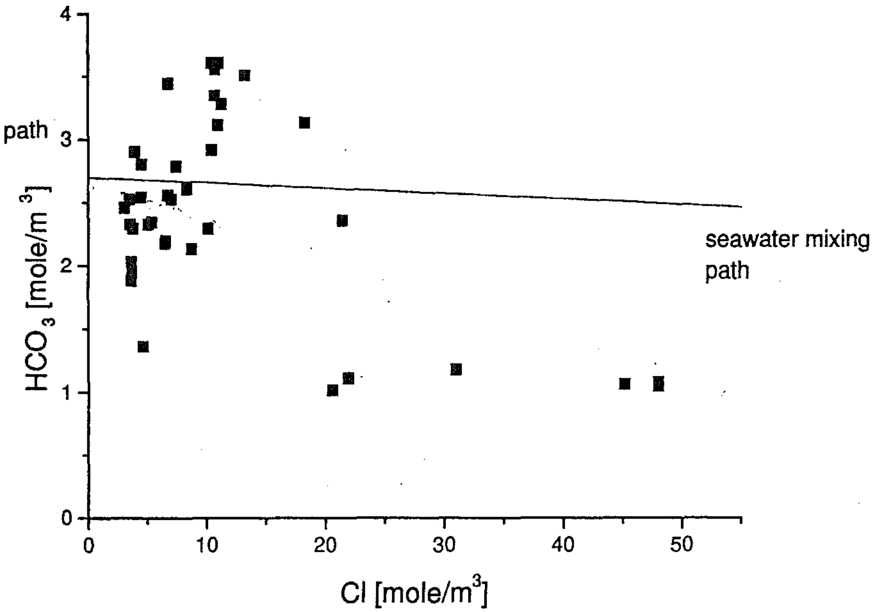


Figure 4.14d Plot of bicarbonate versus chloride for contaminated Heathcote Valley water.

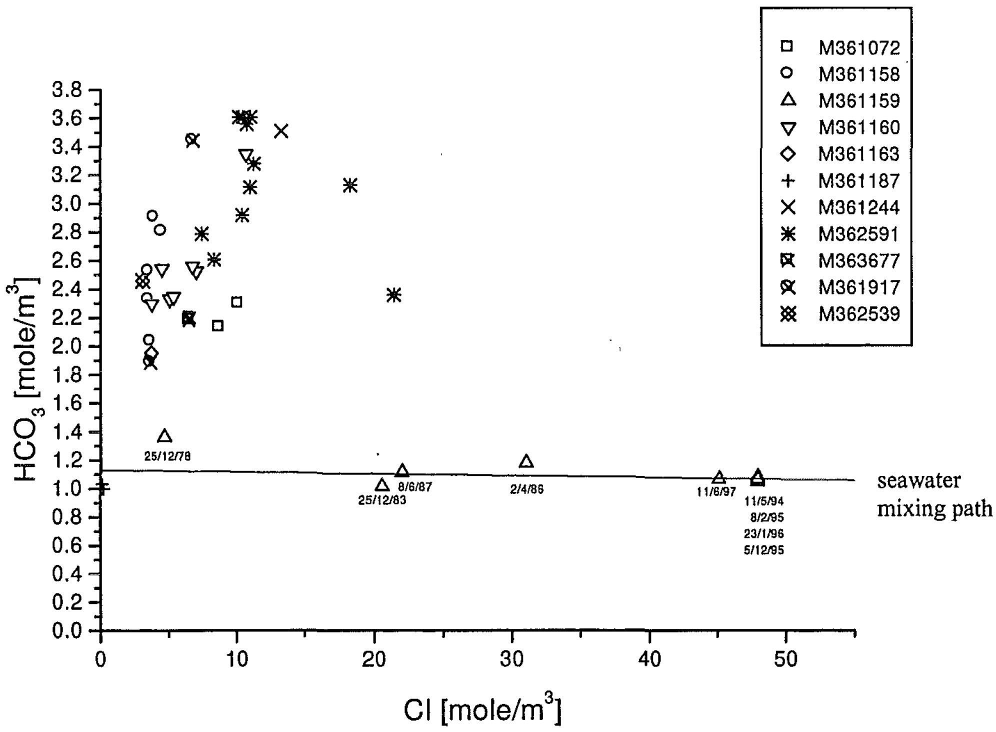


Figure 4.15 Bicarbonate versus chloride concentration for wells within the study area. Samples from the well M36/1159 plot close to a seawater mixing path.

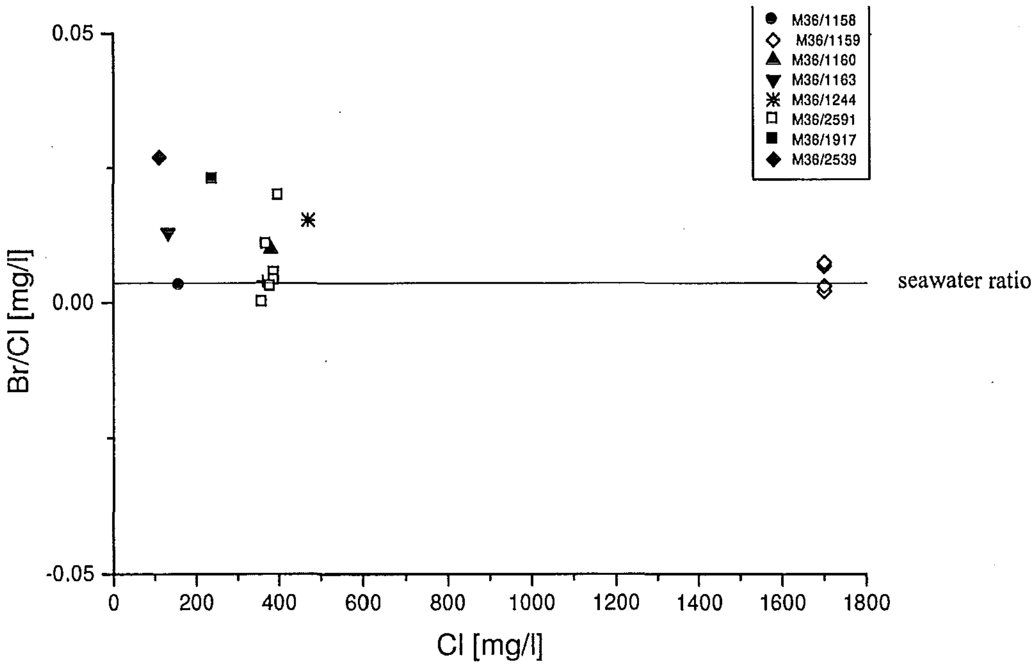


Figure 4.16 Bromide versus chloride ratio. Contaminated water from wells within the study area plots close to the seawater ratio.

4.7 Groundwater contamination from waste leachate from landfills or contaminated sites

4.7.1 General

Landfill sites within and around the Woolston/Heathcote area are shown in Figure 4.17. Apart from other materials, waste from the old Christchurch gas works site, located on Moorhouse Avenue in the central city was also disposed of in the Woolston/Heathcote area as fill in the 1970's when the plant was dismantled. So far only two of the landfills in this area have been investigated to determine their environmental impacts. These are the Ferry Road Tip and the West Truscotts Landfills (see Figure 4.17). The investigations were undertaken by environmental consultants, contracted by the Christchurch City Council in 1996. Each investigation involved installing shallow monitoring bores on each landfill site, collecting groundwater quality samples, and measuring water levels of groundwater within the aquitard. Based on the pattern of Stiff and Piper diagram plots, where groundwater samples of the shallow bores plotted close to seawater, seawater was reported to be present in the shallow bores of the West Truscotts and the Ferry Road Tip landfills (CCC, 1996a and b). Adverse impacts of leachate on underlying aquifers have been regarded as unlikely for each of the landfills due to an upward directed hydraulic gradient and the low permeability of materials at the base of the Riccarton Aquifer (CCC, 1996 a and b). However, the data from the potentiometric survey undertaken at the commencement of this thesis in March 1997 were not available at that time. A synthesis of the information from the investigations of the landfill sites and the more recently obtained Aquifer 1 water levels in the study area clearly indicates that the assumption of an upward hydraulic gradient is not necessarily valid.

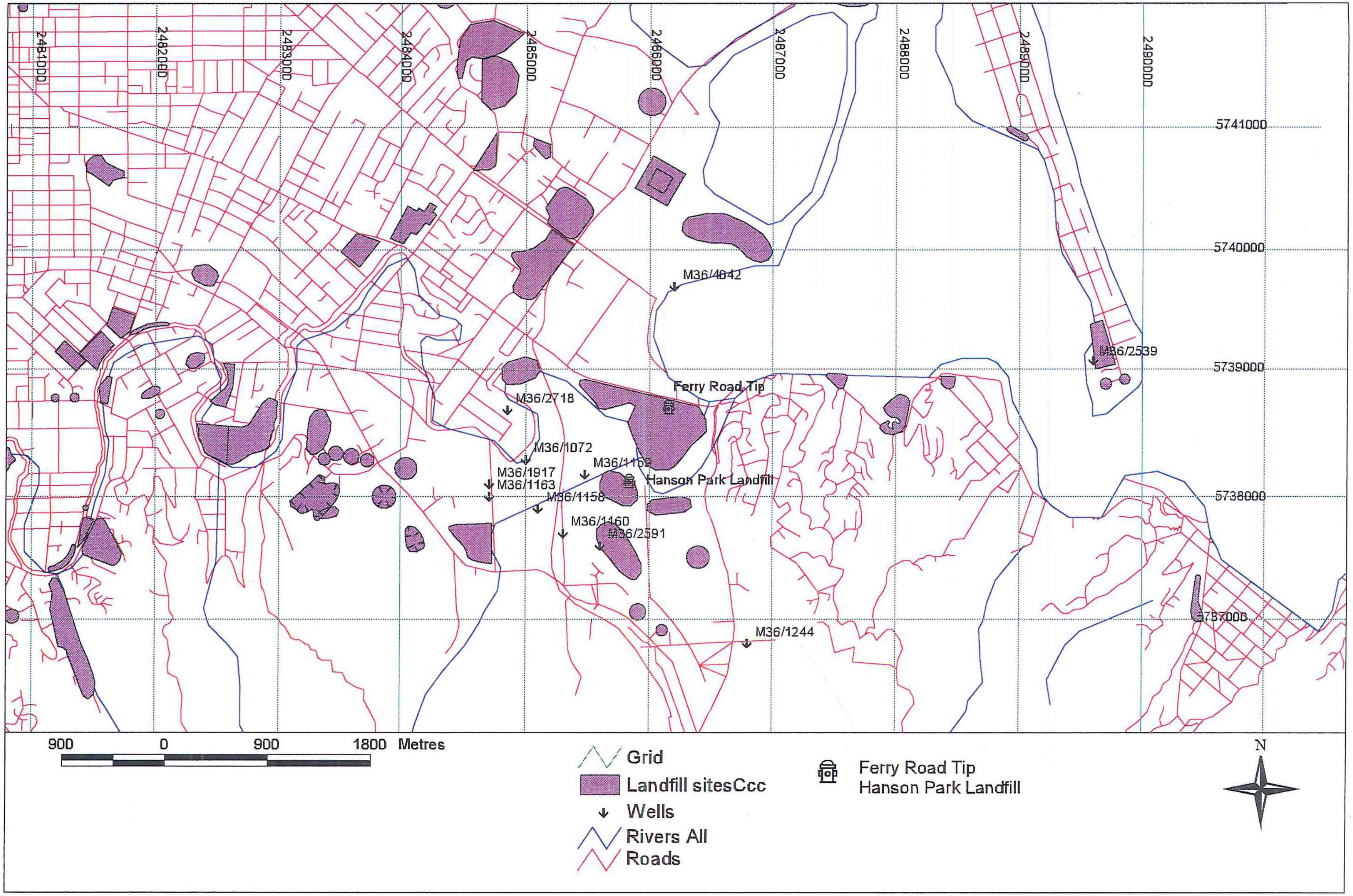


Figure 4.17 Location of landfill sites in and around the study area (taken from CRC database).

4.7.2 The Ferry Road Tip landfill

Industrial refuse, including that from tanneries, woolsheds, a skinnery, soap and candle factory, etc., has been dumped in low lying areas in the Ferry Road vicinity since the 1920's (CCC, 1996a). Concrete and roading material has been disposed of more recently. Figure 4.18 shows the extent of the Ferry Road landfill site and the location of the shallow (up to 6m) observation bores. Wells P1 to P6 were used for water level monitoring while holes BH1 to BH3 were used for both water level and water quality monitoring. The measured range of groundwater quality data and a comparison with seawater is given in Table 4.4. Based on the interpretation of Stiff and Piper diagrams it has been suggested that seawater has influenced the chemistry of groundwater abstracted from each of the monitoring wells. Chloride and sodium concentrations suggest the presence of 17-35% seawater (CCC, 1996a). It is very difficult to fingerprint the amount of contamination due to waste disposal leachate, if seawater is present since most of the leachate constituents are also found in high concentrations in seawater. However, the high concentrations of ammoniacal nitrogen, total phosphorous, arsenic, copper, iron, lead, manganese, nickel and the high alkalinity compared with seawater suggest a considerable amount of contamination by leachate. Unfortunately there are only limited data for groundwater from the aquitard in the area to illustrate the chemistry of groundwater, unaffected by seawater. Well M36/3174 provides such data (see Table 4.5).

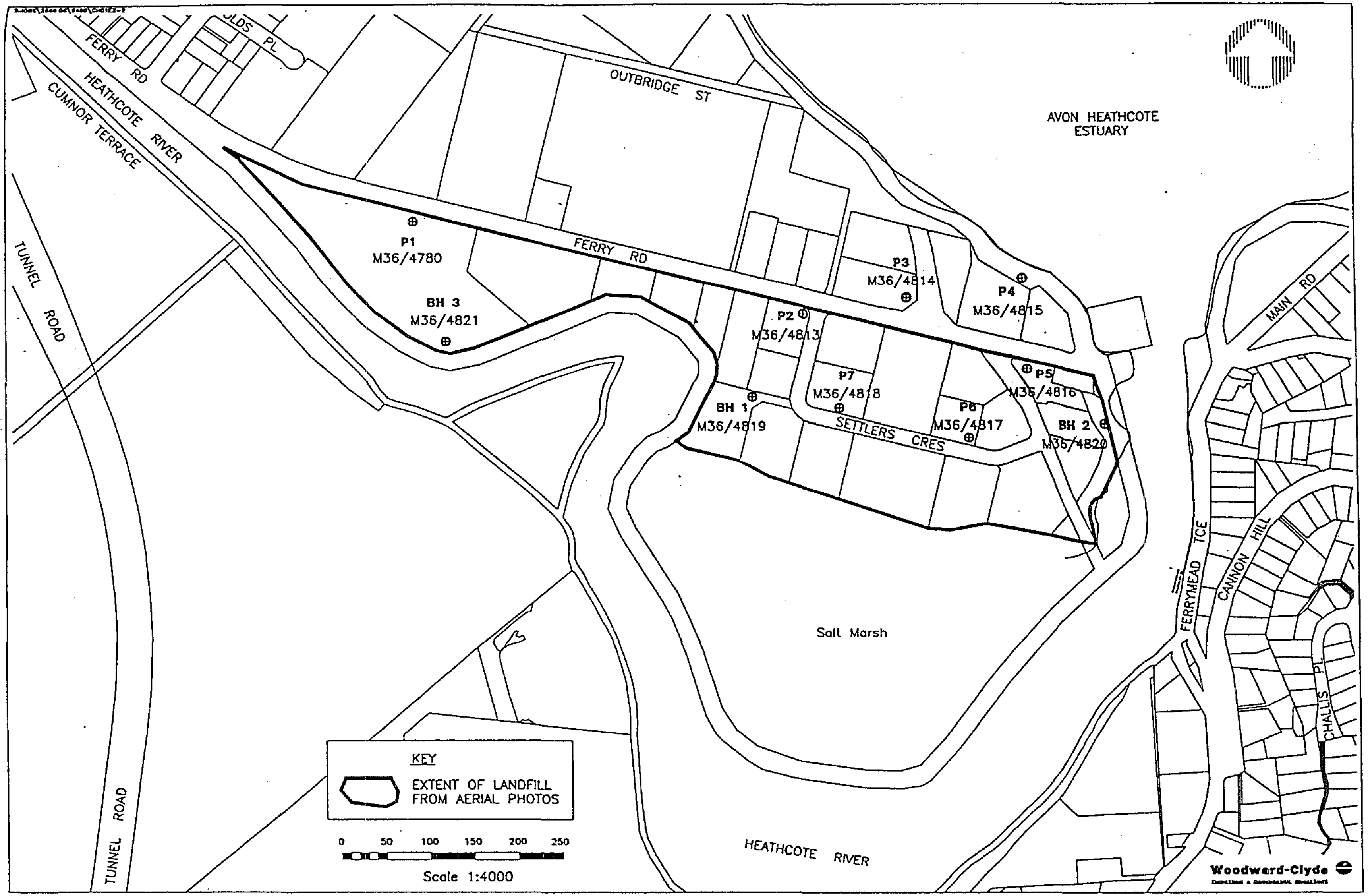


Figure 4.18 The extent of the Ferry Road landfill site and the location of the shallow (up to 6m) observation bores (from CCC,1996a).

Parameter[1]	BH1	BH2	BH3	Typical Composition of Seawater
	Range	Range	Range	Range
pH	6.5-6.8	6.9-7.6	6.8-6.9	6.5-8.5
Conductivity (mS/m)	1,330-1,490	1,120-1,830	1,030-2,000	-
Alkalinity (as $g.m^{-3}$ $CaCO_3$)	124-148	350-400	220-280	116
Total Dissolved Solids	8,662-9,049	6,923-10,137	6,288-13,310	35,000
Calcium	199-260	126-142	102-188	412
Magnesium	330-370	251-350	26-260	1,290
Sodium	2,310-3,300	1,960-3,100	1,840-3,800	10,770
Potassium	61-80	102-135	9-128	399
Chloride	4,000-4,600	3,350-5,700	2,850-7,200	19,350
Sulphate	900-1,250	870-900	1,040-1,800	2,709
Boron	0.78-1.08	1.23-2.3	1.60-1.82	4.44
Nitrite Nitrogen	<0.006	<0.094	<0.02	-
Nitrate Nitrogen	0.006-0.13	0.006-4.7	<0.02	0.1
Ammoniacal Nitrogen	0.11-0.36	0.04-0.14	1.45-1.85	0.005
Total Phosphorous	<0.149	0.008-0.045	0.75-0.97	0.06-0.088
COD	141-280	114-349	58-460	-
Aluminium	0.007-0.046	0.007-0.51	0.008-0.046	0.001-0.0084
Arsenic	0.003-0.009	0.004-0.014	<0.005	0.0005-0.0037
Cadmium	<0.001	<0.0002	<0.001	<0.0094
Chromium	<0.0004	0.0003-0.0006	0.0003-0.0012	0.0002-0.05
Copper	<0.0017	0.001-0.0192	<0.0004	0.00025
Iron (soluble)	0.57-1.79	0.05-0.35	0.55-1.3	-
Iron (total)	1-2.4	0.04-2.5	2.8-10.9	0.00003-0.07
Lead	<0.0006	<0.001	<0.002	0.00003
Manganese	0.12-0.15	0.02-0.06	0.45-0.91	0.0003-0.021
Nickel	<0.007	<0.014	<0.0044	0.00056
Zinc	0.013-0.036	0.019-0.067	0.0057-0.057	0.0002-0.048

Note 1: All values except pH in $g.m^{-3}$ unless otherwise stated

Table 4.4 Groundwater quality of water obtained from shallow observation bores on Ferry Road Tip compared to the typical composition of seawater (from CCC, 1996a).

Well no: M36/3174	pH	NO_3^-	SO_4^{2-}	Cl^-	HCO_3^-
Date: 27/1/1987	6.9	5.8mg/l	5.0mg/l	17mg/l	15mg/l.

Table 4.5 Chemical data for groundwater from the aquitard, which is not contaminated by seawater.

4.7.3 The West Truscotts Landfill

The West Truscotts Landfill was operated by the Heathcote City Council from 1979-1988. According to CCC (1996b) no hazardous wastes were accepted on the West Truscotts Landfill. Industrial wastes were sometimes accepted depending on the material and car bodies, tree stumps, truck loads and fish waste were dumped. Figure 4.19 shows the extent of the landfill site and the location of the three water level and water quality monitoring wells, which were constructed as part of the landfill investigation. Groundwater quality data is shown in Table 4.6. Again it was argued that the shallow groundwater from WT1 and WT3 have been influenced by seawater based on the interpretation of Stiff and Piper diagrams (CCC, 1996b). Groundwater from WT1 was believed to contain moderate concentrations of leachate (CCC, 1996b). Since ammoniacal nitrogen is short-lived in groundwater, rapidly converting to nitrate nitrogen, its presence in high concentrations indicates that the groundwater is affected by a nearby ammoniacal nitrogen source - probably refuse. The high concentrations in ammoniacal nitrogen and the young age of the landfill site suggest that the waste is still actively decomposing.

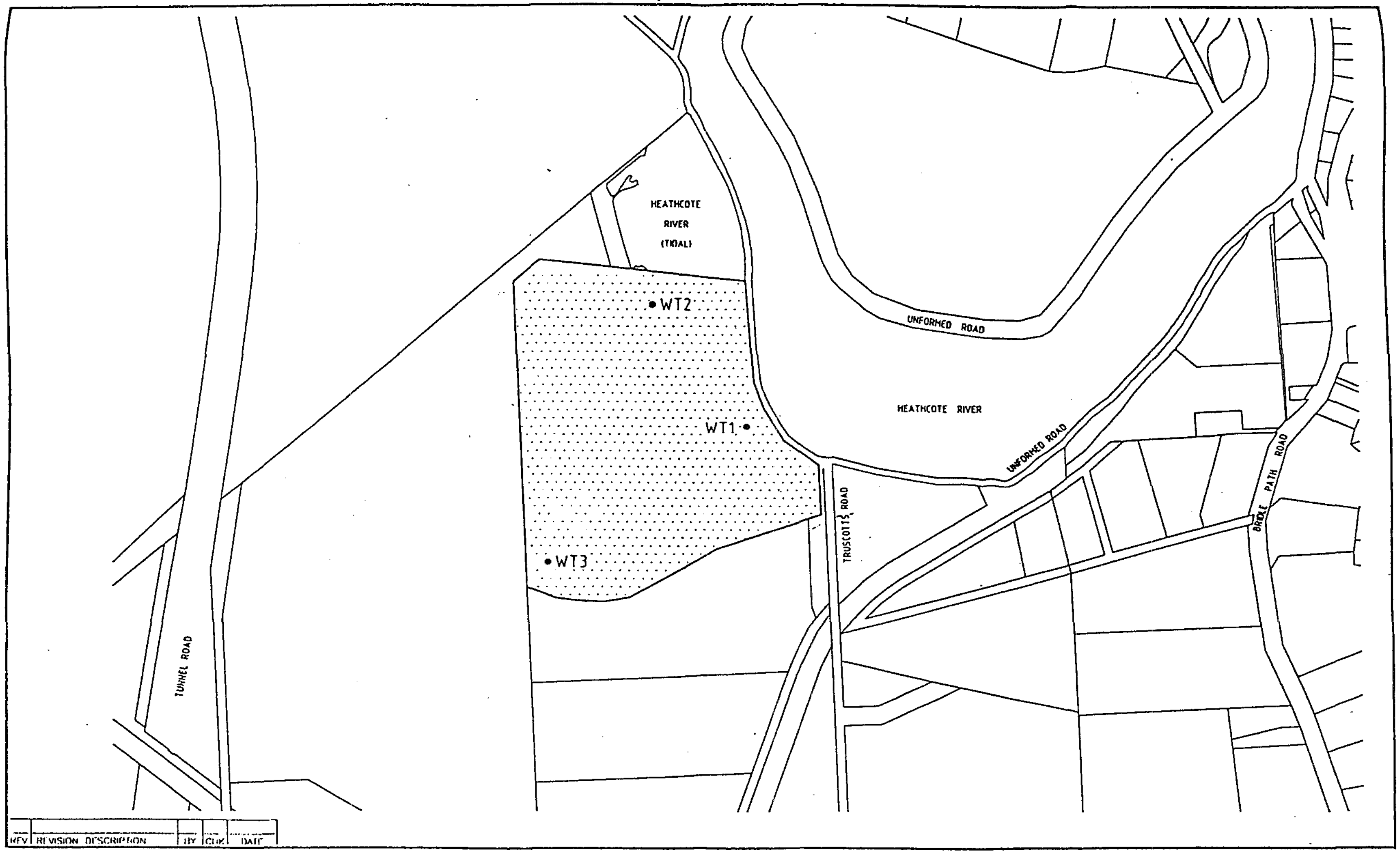


Figure 4.19 The extent of the West Truscotts landfill site and the location of the three water level and water quality monitoring wells (from CCC, 1996b).

Parameter[1]	WT1[2]	WT2[3]	WT3[2]	Typical Composition of Seawater
pH	7.1	7.1	6.8	6.5-8.5
Conductivity (mS/m)	530	1,270	2,240	-
Hardness (as $g.m^{-3}$ $CaCO_3$)	1,180	1,660	1,860	-
Alkalinity (as $g.m^{-3}$ $CaCO_3$)	1,570	2,120	737	116
Suspended Solids	121	295	2,130	-
Calcium (soluble)	282	229	141	412
Magnesium (soluble)	116	263	366	1,290
Sodium (soluble)	419	2,430	3,280	10,770
Potassium (soluble)	214	246	155	399
Chloride	390	3,500	6,000	19,350
Sulphate	464	90	1,540	2,709
Boron (soluble)	4.62	2.58	2.99	4.44
Nitrite Nitrogen	0.005	0.002	0.008	-
Nitrate Nitrogen	0.041	0.169	0.007	0.1
Ammoniacal Nitrogen	50	158	12	0.005
Total Phosphorous	0.838	0.589	0.041	0.06-0.088
COD	3,460	755	-	-
Aluminium (soluble)	0.050	0.13	0.08	0.001-0.0084
Arsenic (soluble)	0.008	0.008	0.03	0.0005-0.0037
Cadmium (soluble)	<0.0001	<0.0005	0.0009	<0.0094
Chromium (soluble)	0.0120	0.0150	0.0350	0.0002-0.05
Copper (soluble)	0.002	0.0014	0.012	0.00025
Iron (soluble)	13.7	38.1	2.61	-
Iron (total)	21.5	61.9	40.3	0.00003-0.07
Lead (soluble)	0.0019	0.036	0.004	0.00003
Manganese (soluble)	1.62	3.10	0.294	0.0003-0.021
Nickel (soluble)	0.004	0.02	0.03	0.00056
Zinc (soluble)	0.039	0.15	0.06	0.0002-0.048

Notes:
1. All values except pH in $g.m^{-3}$ unless otherwise stated
2. Sample collected on 21 August 1996
3. Sample collected on 30 August 1996

Table 4.6 Groundwater quality of groundwater from the observation bores in comparison to seawater (from CCC, 1996b).

4.7.4 Groundwater levels

Figure 4.20 shows the water levels for the Riccarton aquifer, obtained from the potentiometric survey of the 2nd March 1997 at 11^{00} hours NZST, which was half an hour after high tide. Unfortunately there are no water level data of groundwater within the overlying aquitard, which corresponds to this time. Instead the water level data available from the aquitard of the Ferry Road Tip landfill site, which were obtained on the 19th July 1995 at about 1pm (from CCC, 1996a) at high tide, were used for comparison. They are estimated to be about 10-30cm higher than in March due to seasonal fluctuations. The tidal state during the collection of water level data from the West Truscotts Landfill (from CCC 1996b) on the 1st May 1995 is unknown. No time of sample collection was recorded either in the report, or on the field sheets. High water levels at this site could be due to perched water levels and therefore may not reflect the true conditions for the aquitard. Despite the large time lag between water level measurements there is a good indication that the hydraulic gradient between Aquifer 1 and the aquitard may be reversed at least during high tides.

4.7.5 Chemical evidence of groundwater contamination from landfill leachate

To examine whether the groundwater from Aquifer 1 in the Woolston/Heathcote area is contaminated by landfill leachate those ions, which are generally found to be present at lower concentrations in seawater than in landfill leachate were used. These generally include nitrite nitrogen, nitrate nitrogen, ammoniacal nitrogen, phosphorous, carbon dioxide, iron, manganese, bicarbonate, zinc, nickel, lead, copper, and arsenic. However, the available data on each of these ions are restricted. In Table 4.7 ion concentrations of nitrate nitrogen, ammoniacal nitrogen, dissolved reactive phosphorus, bicarbonate, chloride, carbon dioxide, iron, and manganese of the contaminated groundwater from wells within the study area, are compared with estuarine water (sample taken at Tidal View at Ferry road Tip, 17th June 1997 at 14^{10} o'clock, at high tide). For well locations see Figure 4.17. Ion concentrations, which exceed the estuarine water quality are shown as **bolded**. Groundwater from within the area of low potentiometric pressure in Woolston/Heathcote contains higher concentrations in manganese, iron, carbon dioxide, bicarbonate and nitrate nitrogen than estuarine water. The increased carbon dioxide, bicarbonate and nitrate nitrogen concentrations could derive from the decomposition of biodegradable materials under aerobic conditions. In order to find out whether high manganese or iron concentrations could be derived from mixing with Banks Peninsula groundwater, water from wells which intersect volcanic rock (wells cited in BROWN and WEEBER, 1994) have been examined for their iron and manganese content (for well locations see Appendix C.1; for water quality data see Appendix C.2). These are generally low, approximately 0-0.05mg/l for manganese and 0-0.21mg/l for iron. Therefore it is not likely that the increased manganese and iron concentrations are related to mixing with Banks Peninsula groundwater. Especially high concentrations of ammoniacal nitrogen, dissolved reactive phosphorus, carbon dioxide, manganese, and iron have been observed in groundwater from the well M36/2539 on South New Brighton Spit (see Table 4.7). Peat deposits could also be responsible for the increased concentrations in those ions. However, the increased chloride concentrations can not be explained by the presence of peat deposits and the well is located near a landfill site. As hydraulic heads of the well M36/2539 are too high, to induce downward leakage, the contamination is suspected to be related to vertical leakage due to leaky well casings. However, more study needs to be undertaken to confirm this. Also the well M36/2591 has high concentrations of nitrate nitrogen, bicarbonate, dissolved reactive phosphorus, carbon dioxide, manganese, iron and chloride (see Table 4.7) and is situated close to a landfill site. As previously indicated groundwater from the well shows similar trends in bicarbonate and chloride concentrations at similar times, which can not be explained by contamination from seawater or peat deposits but by contamination from landfill leachate. It can therefore be concluded that groundwater from some wells in the Heathcote Valley, and a well on South New Brighton Spit are likely to be affected by some contamination from landfill leachate.

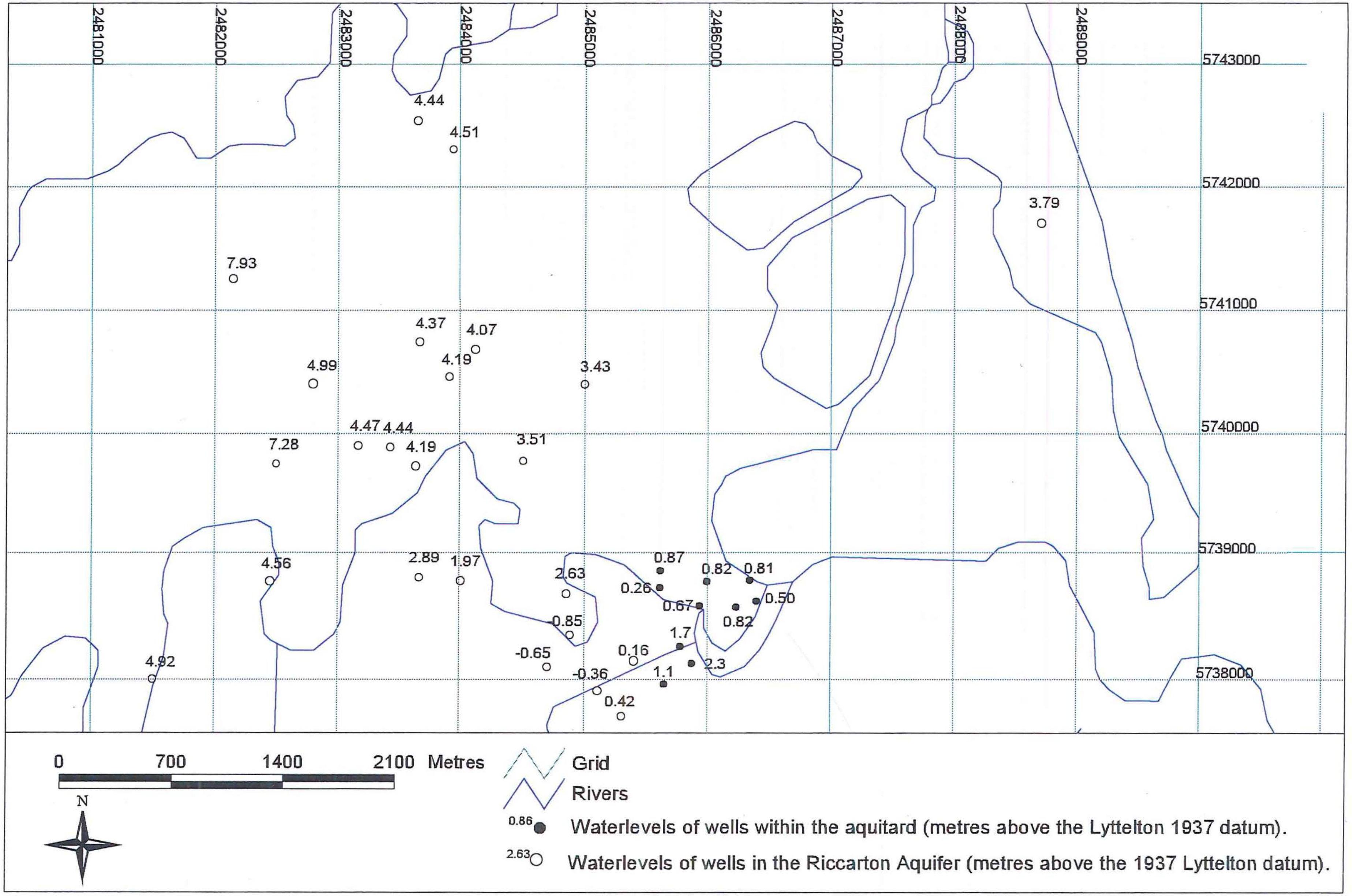


Figure 4.20 Summary of water level data from the Aquifer 1 potentiometric survey (1997) and water level data from wells within the aquitard (data from June 1995; source CRC, 1996a and b).

SITE NO	DATE	pH	NO3N [g/m3]	NH3N [g/m3]	DRP [g/m3]	HCO3 [g/m3]	CL [g/m3]	CO2 [g/m3]	FED [g/m3]	MND [g/m3]
M36/1072	11/06/97	7.8				**130**	310		0.06	0.02
M36/1158	11/05/94	7.6	0.2			**171**	160		**1.7**	0.02
M36/1159	8/02/95	7.1	0.05	0.009	0.011	64	1700	**8**	**0.3**	**0.34**
M36/1160	8/06/87	7.3	0.075	0		**155**	160	**10**	0	**0.9**
M36/1163	25/05/94	7.8	0.3			**119**	132		0.05	0.01
M36/1244	11/05/94	6.8	**19**			**214**	470		0.05	**0.04**
M36/2591	7/02/95	7.2	**3.2**	0.009	0.27	**220**	370	**22**	0.1	**1.06**
M36/1917	19/06/97	7.7	0.62	0.006	0.09	**210**	240	**7**	0.06	0.02
M36/2718	19/06/97	9.6	0.005	0.3	0.007	21	36	0	0.06	**0.09**
M36/4042	17/06/97	7.6	0.005	0.32	0.042	111	11	**5**	**0.41**	**0.21**
M36/2539	17/06/97	7.2	0.005	**4.3**	0.24	**150**	110	**16**	**1.7**	**0.39**
Mean		7.6	**2.346**	0.706	0.11	**142**	336	**10**	**0.408**	**0.28**
Heathcote Estuary		7.9	1.7	1.7	0.3	116	14000	2	0.24	0.02

Table 4.7 Ion concentrations of ions, which typically occur in landfill leachate, of groundwater from wells (for locations see Figure 4.17) within the study area, are compared with estuarine water (sample taken at Tidal View at Ferry road Tip, 17th June 1997 at 14^{10} o'clock, at high tide).

4.8 Leaky well casings

Some groundwater contamination in the study area was observed from one Aquifer 2 well (well no: M36/4595, owned by GL Bowron), which exhibited chloride concentrations of 40mg/l and one Aquifer 3 well (well no: M36/1149, owned by Lyttelton Water Supply), which showed chloride concentrations of 130mg/l (for well location see Figure 4.21). As there is an upward hydraulic gradient between the two aquifers and the estuary the cause of contamination is unclear. It is suspected to be the result of vertical leakage, caused by leaky piezometers and/or well casings.

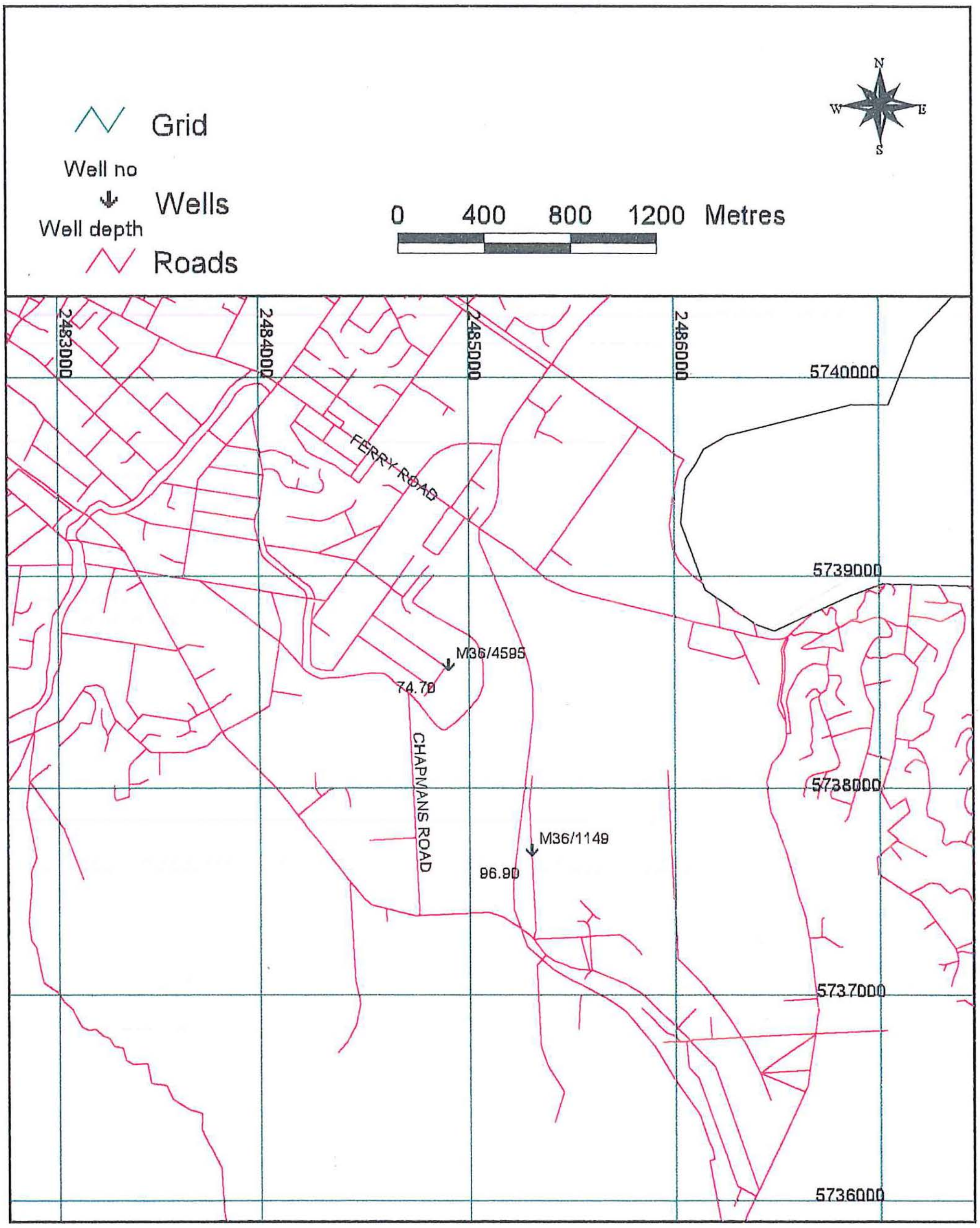


Figure 4.21 Locations of the Aquifer 2 well M36/4595, and the Aquifer 3 well M36/1149 which are possibly affected by contamination due to vertical leakage through leaky piezometers and/or well casings.

4.9 Conclusions

Groundwater contamination occurs in the south-eastern part of Christchurch City in the Heathcote Valley and in the southern part of South New Brighton Spit. The cause for groundwater contamination is likely to be a downward hydraulic gradient between the estuary and Aquifer 1. Aquifer 1 hydraulic heads are drawn below sea level in the Heathcote Valley due to groundwater abstractions in the area. Consequently contaminants from the estuary and from landfills, dumped in the uppermost confining layer, are drawn downward and pollute Aquifer 1. Leaky well casings may contribute to vertical leakage of the contaminants through the confining layer.

At this point of the investigation a number of information deficiencies were identified. These include:

1. The potential risk of seawater intrusion for the Christchurch artesian aquifer system has not been studied in great detail. This problem is therefore investigated in Chapter 5.
2. The network of Aquifer 1 groundwater quality monitoring wells in the Woolston/Heathcote area has a significant gap at Ferry Road Tip and there is no monitoring of the vertical hydraulic gradient in the study area. These issues and proposed future management strategies to remediate the adverse environmental effects from over abstraction in the Heathcote area have been addressed in Chapter 6.

5 A cross-sectional groundwater model to simulate the freshwater/seawater interface along the coast of Christchurch

5.1 General

Seawater intrusion has been recognised as a potential risk for the Christchurch artesian aquifer system in the past few years. However, little research has been undertaken to investigate the problem. In a conceptual model TALBOT *et al.* (1986) indicated the location of the freshwater/seawater interface at approximately 40km offshore, where the Riccarton Aquifer is believed to intersect with the sea, implying that the risk of seawater intrusion near Christchurch is relatively low. However, pump test data have identified the top confining layer as leaky (TALBOT *et al.*, 1986). Consequently freshwater discharge to the sea is not restricted to the outcrop of the Riccarton Aquifer, but occurs continually through the top confining layer, following the upward directed hydraulic gradient. As a result the freshwater/seawater interface is to be expected much closer to the shoreline. In this study the interface location was considered using a modelling approach. A cross-sectional 1km wide and 50km long groundwater flow model has been constructed to simulate freshwater and saltwater flow for the Christchurch artesian aquifer system, using the quasi-three dimensional finite-difference SHARP modelling software by HEDEFF ESSAID (1990a).

5.2 Introduction to seawater intrusion approaches

In the late 1800's the Dutch and the German scientists, Ghyben and Herzberg, independently discovered that the depth to the freshwater/seawater interface below sea level in confined or unconfined coastal aquifers equals 40 times the freshwater hydraulic head or water level above sea level.

The resulting equation is known as the Ghyben-Herzberg relationship:

$$z = \frac{\rho_f}{\rho_s - \rho_f} h_f = 40 h_f$$

where z = depth of the interface below sea level

ρ_f = density of freshwater

ρ_s = density of seawater

h_f = elevation of the freshwater hydraulic head above sea level

The Ghyben-Herzberg relationship can be applied to unconfined and confined aquifers, but only gives satisfactory results if the groundwater flow is nearly horizontal because it assumes that the groundwater head at the water table is the same as the head of the freshwater at the interface. Another problem is that the presence of a freshwater zone at the shoreline due to freshwater discharge to the sea is neglected, since the water-table elevation is zero at the shore (REILLY AND GOODMAN, 1985). 4 shows the position of an interface according to the Ghyben-Herzberg relationship.

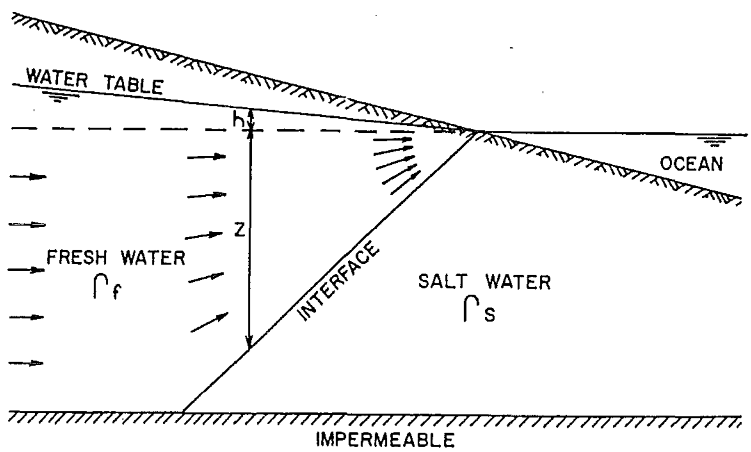


Figure 5.1 The freshwater-seawater interface in a coastal aquifer draining into the sea according to the Ghyben-Herzberg relationship (from BOWER, 1978).

GLOVER (1964) described a sharp, non-static interface under steady-flow conditions for a coastal aquifer (see Figure 5.2). His formulation takes into account freshwater discharge over an area and vertical flow components in the aquifer as the freshwater moves up along the interface (BOUWER, 1978). The width W of the freshwater discharge gap is described by:

$$W = \frac{q}{2(\rho_s - \rho_f)K}$$

where: W= width of the freshwater discharge gap

q= flow in aquifer per unit length of shoreline

K= hydraulic conductivity of aquifer

The depth of the freshwater-saltwater interface beneath the shoreline is described as:

$$z_o = \frac{q}{K(\rho_s - \rho_f)}$$

where: z_0= the freshwater/saltwater interface beneath the shoreline

q= flow in aquifer per unit length of shoreline

K= hydraulic conductivity of aquifer

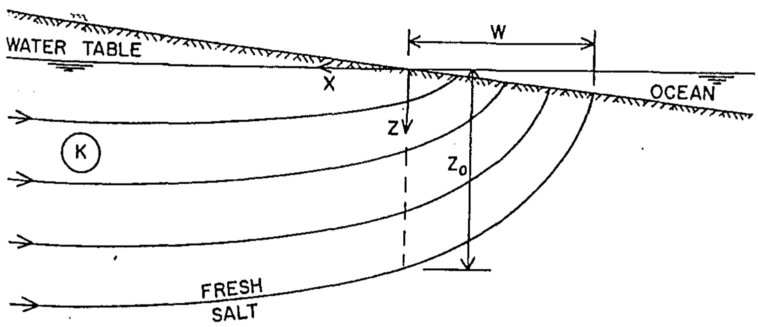


Figure 5.2 Geometry and symbols for Glover's solution of the freshwater-seawater interface (from BOUWER, 1978).

Computer models allow the simulation of the freshwater/seawater interface in 2 ways:

1. The dispersed interface approach takes the effects of hydrodynamic dispersion (molecular and mechanical dispersion) into account. Hydrodynamic dispersion causes the mixing of freshwater and seawater resulting in a transitional interface zone (see Figure 5.3).
2. The sharp interface approach neglects the effects of hydrodynamic dispersion and simplifies the model by assuming a sharp interface separating the freshwater zone from the saltwater zone.

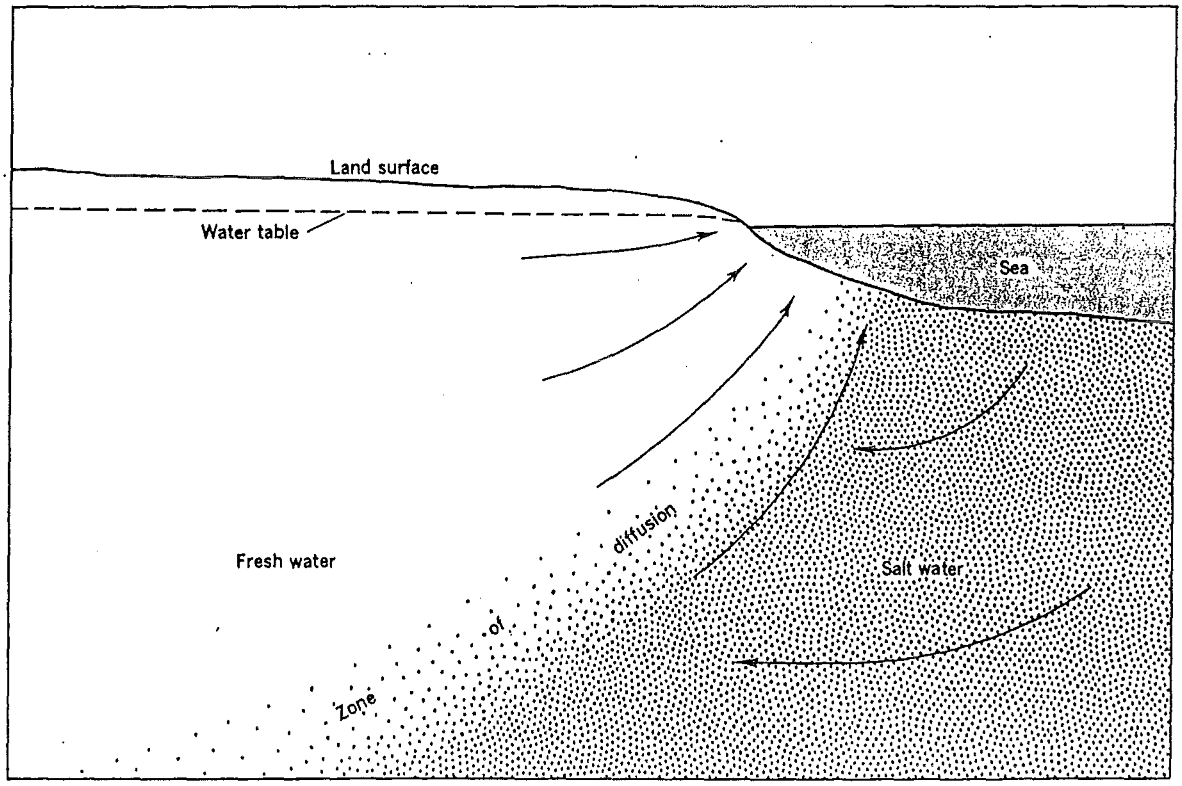


Figure 5.3 Circulation of saltwater from the sea to the transition zone and back to the sea induced by mixing at the interface (from HILTON AND COOPER, 1964).

Analytical and numerical models have been developed for both approaches. However, problems in simulating a dispersed interface in three dimensions arise because too much computational effort is demanded to solve solute transport and flow equations simultaneously. The assumption of a sharp interface simplifies the modelling approach to such a degree that regional-scale studies of multilayered coastal aquifers such as the Christchurch artesian aquifers can be accommodated. Seawater intrudes separately into each aquifer and the seawater wedge may extend offshore.

The sharp interface approach should only be used if the transition zone is small relative to the extent of the aquifer system. If the interface zone is wide a dispersed interface model should be applied (ESSAID, 1990b).

Sharp interface models can be divided into two categories:

1. Models simulating coupled freshwater and saltwater flow dynamics (two-fluid approach).
2. Models simulating freshwater flow dynamic only (one-fluid approach).

There are few sharp interface models available for layered coastal aquifer systems. COLLINS AND GELHAR (1971) presented a one-fluid analytical description of an intruding seawater wedge beneath a semipervious layer. They concluded that the location of a seawater wedge beneath a semipervious layer depends on the head conditions at the landward limit of the semipervious layer and on the vertical flow through the semipervious layer. A numerical two-fluid sharp interface model for one dimensional-flow in a two-layered aquifer separated by a thin impervious layer has been developed by BEAR and KAPULER (1981). SAPIK (1988) developed a one-fluid approach sharp interface model simulating steady-state conditions for a multilayered aquifer system (cited in ESSAID, 1990a). SHARP by ESSAID (1990a) was the first quasi three-dimensional, numerical finite difference model to simulate coupled freshwater and saltwater flow separated by a sharp interface in layered coastal aquifer systems. According to ESSAID (1990b), in many cases the two-fluid approach should be applied in order to simulate the short-term behaviour of a coastal aquifer system more accurately. In this approach the hydraulic heads of fresh and saltwater are used as the dependent variables. Since then HUYAKORN *et al.* (1996) have created a sharp interface two-fluid numerical model for multilayered coastal aquifer systems. They used a mixed formulation having the freshwater hydraulic head and the normalised thicknesses of the freshwater lens and the saltwater wedge as the dependent variables.

5.3 Model selection

In order to achieve satisfactory results with the given tools it is important to choose a groundwater model by considering the following questions:

- What is the purpose of the modelling effort? What questions should the model address?
- Which type of model (e.g. analytical or numerical, physical or mathematical, one-two- or three-dimensional) is best suited to simulate the given hydrogeological system and to address the questions?
- What are the aquifer parameters the model needs to be supplied with? Are there sufficient data on these parameters and how accurate are they?
- How realistic is the modelling effort?

In this study, a sharp interface model was used because it was a primary aim to locate the position of the interface rather than to obtain details of its nature (e.g., width of the transition zone). If more details on the nature of the interface are required in future a disperse interface model might be easier to run with the information obtained by using first the sharp interface approach. Another reason for choice is the simplicity of the sharp interface model compared with a full density-dependent model. There are some indications that parts of the Christchurch aquifer system might be affected by seawater intrusion due to pumping. Consequently it was necessary to choose a model capable of considering pumping simulations, to provide information on the stresses that can be sustained by the aquifer system. In a quasi three-dimensional model only three layers are needed to simulate three aquifers, which facilitates the modelling exercise. Therefore the quasi three-dimensional finite-difference groundwater flow model SHARP (ESSAID, 1990a) was chosen to test simulation for the multilayered Christchurch aquifer system.

5.4 Definition of SHARP as a groundwater model

SHARP is a **mathematical model,** which simulates aquifer properties by solving basic equations of ground-water flow. Mathematical models can be either **analytical** or **numerical. Analytical models** calculate the equations directly so that boundary conditions must be simple. **Numerical models** calculate numerical approximations of the equations and should be used if the model area varies or if boundary conditions are complex. Modelling approaches can either be **finite-element** or **finite-difference. Finite element models** divide the aquifer system into cells of arbitrary size and polygonal shape in order to obtain a numerical solution for flow. **Finite-difference models** divide the aquifer system into rectangular cells and flow is calculated for every single cell of the grid (see Figure 5.4). This implies that the models are discretized rather than continuous. The equations are solved at node points, which fall into the centre of the block centred grid (FETTER, 1988). The strongly implicit procedure (SIP) (STONE, 1968, cited in ESSAID, 1990b) is used to solve the discretized system (due to the finite-difference grid) of equations (ESSAID, 1990b). Grid spacing can be varied and should be dense close to the interface to locate it more accurately.

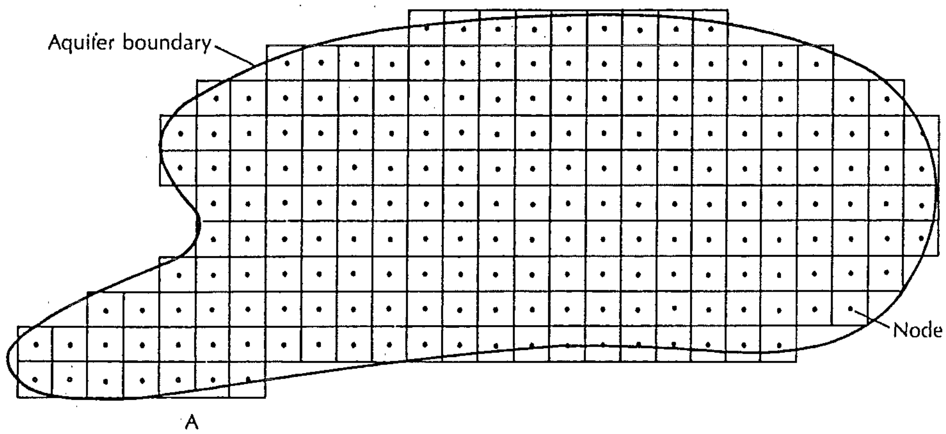


Figure 5.4 A Block-centred finite-difference grid laid over an aquifer (from FETTER, 1988).

Quasi three-dimensional groundwater flow models provide a solution for the distribution of heads and simulate a sequence of aquifers, separated by confining layers. The upper aquifer can be confined, unconfined or semi-confined. The heads of the aquifers are calculated whereas the aquitards are characterised by leakage terms. A schematic view of a quasi three-dimensional model is given in Figure 5.5.

In order to calculate leakage through a confining layer the release of water stored within the confining layer is neglected and flow between two aquifers is assumed to be vertical. Under these conditions the leakage term is a function of vertical hydraulic conductivity and the head difference across the confining bed.

A **quasi three-dimensional model** should only be applied if the hydraulic conductivity of the aquifer is at least two orders higher than the hydraulic conductivity of the confining layer. Only under these conditions flow through the confining layer is nearly vertical (FREEZE and CHERRY, 1979, cited in ESSAID, 1990a). This is the case for the Christchurch aquifer system.

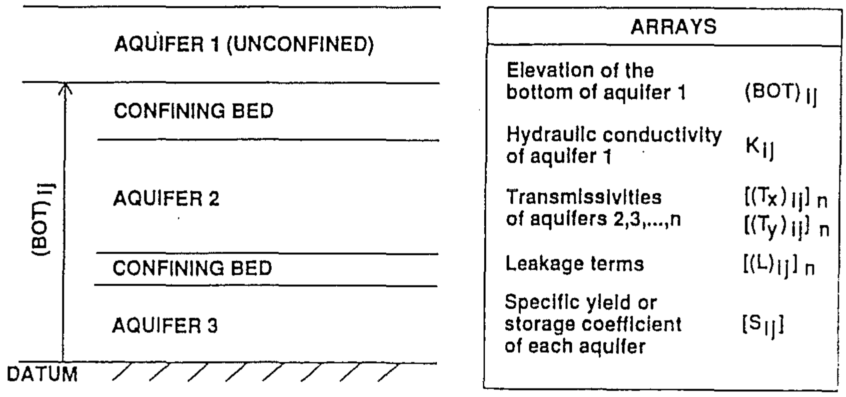


Figure 5.5 Schematic view of a quasi three-dimensional model. The leakage properties of the confining beds, (Li,j)n, are used to connect Aquifers 1, 2, and 3. The confining beds are not represented as model layers, nor are storage properties of confining beds included in the model (from ANDERSON and WOESSNER, 1992).

Simulations by SHARP can either be steady-state or transient. At steady-state the system is represented at equilibrium (inputs equal outputs) and there is no change in storage. SHARP approximates steady-state conditions by using the governing transient equations over a long simulation period until there is almost no change in storage. A transient solution represents the aquifers time dependent response to changes, such as pumpage or seasonal recharge fluctuations. Figure 5.6 illustrates cross-sections of a layered coastal aquifer for steady-state and transient simulations.

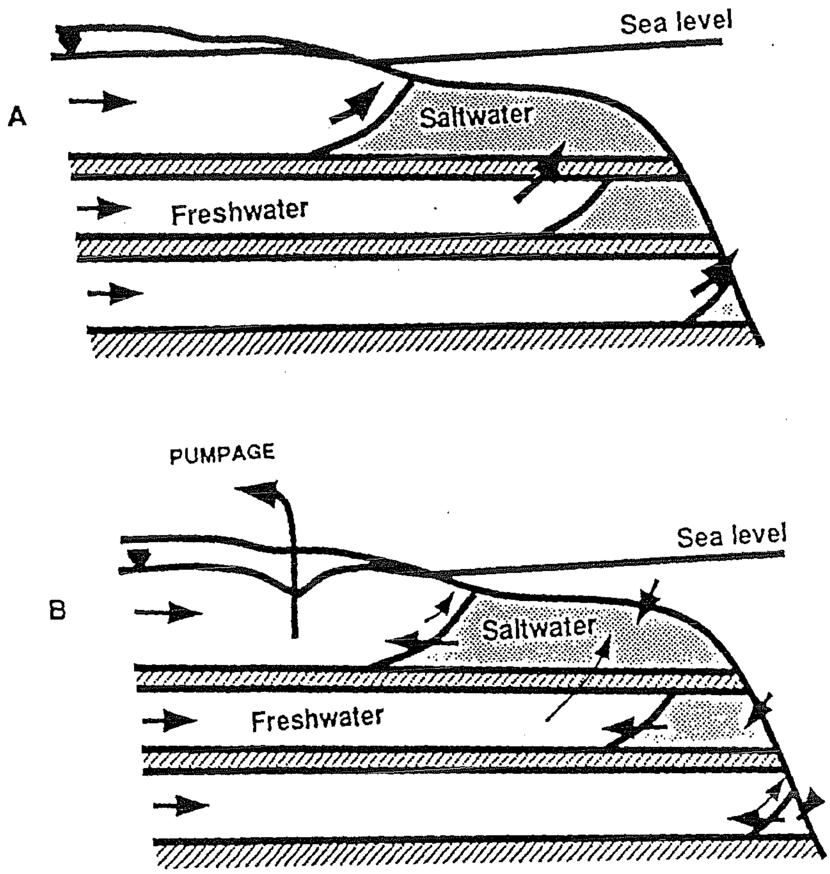


Figure 5.6 Idealised cross-section of a layered coastal aquifer system showing paths of freshwater discharge and potential paths for saltwater intrusion (from Essaid, 1990b):

A. A steady-state system with constant freshwater discharge offshore.

B. transient system with intruding saltwater and inland interface movement.

5.5 Governing equations

SHARP solves for the freshwater (ϕ_f) and saltwater head (ϕ_s) simultaneously by integrating the freshwater and saltwater flow equations over the vertical axis and assuming horizontal flow within the aquifer as follows (ESSAID, 1990b):

$$S_f B_f \frac{\partial \phi_f}{\partial t} + n\alpha \frac{\partial \phi_f}{\partial t} + \left[n\delta \frac{\partial \phi_f}{\partial t} - n(1+\delta)\frac{\partial \phi_s}{\partial t} \right] =$$

$$= \frac{\partial}{\partial x}\left(B_f K_{fx} \frac{\partial \phi_f}{\partial x} \right) + \frac{\partial}{\partial y}\left(B_f K_{fy} \frac{\partial \phi_f}{\partial y} \right) + Q_f + Q_{lf}$$

$$S_s B_s \frac{\partial \phi_s}{\partial t} + \left[n(1+\delta)\frac{\partial \phi_s}{\partial t} - n\partial \frac{\partial \phi_f}{\partial t} \right]$$

$$= \frac{\partial}{\partial x}\left(B_s K_{sx} \frac{\partial \phi_s}{\partial x} \right) + \frac{\partial}{\partial y}\left(B_s K_{sy} \frac{\partial \phi_s}{\partial y} \right) + Q_s + Q_{ls}$$

where:

ϕ_f, ϕ_s = the vertically averaged fresh and saltwater heads, respectively (L, length);

S_f, S_s = the fresh and saltwater specific storages (L-1);

B_f, B_s = thickness of the fresh and saltwater zones (L);

n = porosity

δ = $\gamma_f(\gamma_s\text{-}\gamma_f)$

γ_f, γ_s = the fresh and saltwater hydraulic conductivities in the x-direction (LT-1)

K_{fy}, K_{sx} = fresh and saltwater hydraulic conductivities in the y-direction (LT-1);

K_{fy}, K_{sy} = fresh and saltwater hydraulic conductivities in the y-direction(LT-1);

Q_f, Q_s = fresh and saltwater leakage terms (LT-1);

α = 1 for an unconfined aquifer, = 0 for a confined aquifer:

t = time

The interface elevation (ζ_l) is calculated using the previously obtained freshwater and saltwater head as follows:

$$\zeta_l = (1+\delta)\phi_s - \delta\phi_f$$

Leakage between two aquifers is calculated by Darcy's Law for density-dependent flow under the assumption that flow between two aquifers is vertical and the effects of storage within the confining layer are negligible:

$$q_l = -\left(\frac{K'}{B'}\right)(\Phi_a - \Phi_b)$$

where:

q_l= vertical leakage (positive upward) (L/T^{-1})

$\frac{K'}{B'}$ = leakance of the confining layer (T^{-1})

K'= vertical hydraulic conductivity of the aquitard (L/T^{-1})

B'= thickness of the aquitard (L)

Φ_a=hydraulic head above confining layer

Φ_b=hydraulic head below confining layer

5.6 Model framework

5.6.1 Geometry

The model geometry is illustrated by Figure 5.7. A 1km wide horizontal slice oriented along the Aquifer 1 groundwater flow direction was chosen extending 10km inland from the coastline and 44km out to the sea. The model consists of three layers. Layers one to three represent the Burwood, Linwood, and Riccarton Aquifer, respectively. The outcrop of the Riccarton Aquifer is exposed at 40km offshore. The Linwood and Burwood aquifers pinch out. The location of the simulated onshore cross-sectional area in Christchurch is indicated in Appendix D.1.

Aquifer and aquitard thicknesses (see Table 5.1) in the simulated area were obtained from the recently compiled Christchurch-West Melton groundwater report by CRC (1997a). The thickness of the uppermost aquitard and Aquifer 1 were varied as described in CRC (1997a), however, other layers were kept constant.

The horizontal model grid is split into 3 rows and 30 columns. Each row is a 1000m wide. The two outside rows and two end columns are defined as no flow boundaries and represent groundwater flow lines as defined by the potentiometric contours of the area. Therefore the model can be essentially viewed as a two-dimensional cross-section. Column spacing is closest near the coast (500m) and increases up to 4610 m to the west and 5220 m to the east.

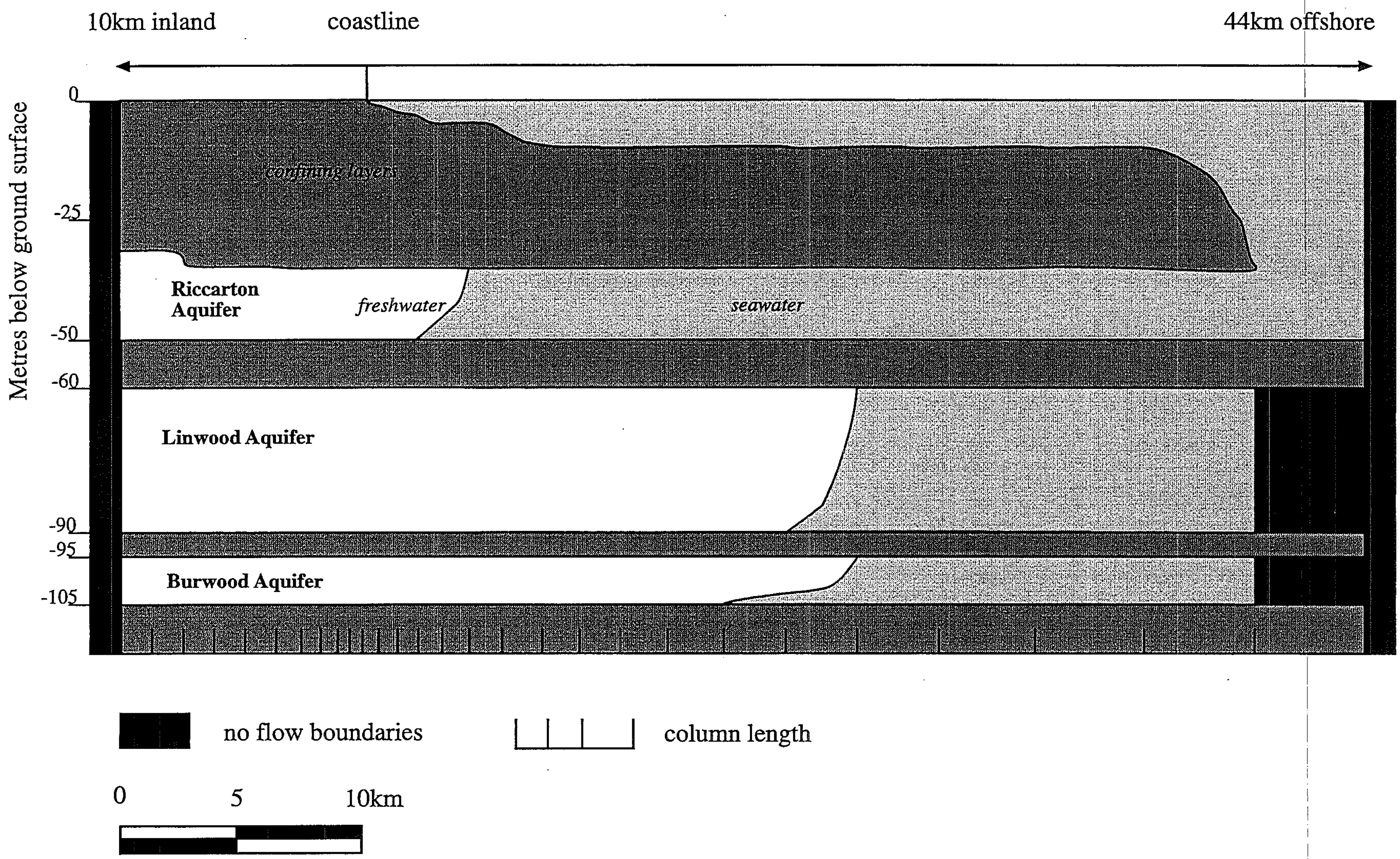


Figure 5.7 Geometry of the constructed groundwater model. The simulated interface position at steady-state for each aquifer is indicated.

Aquifer	*Aquifer bottom [m]*	*Aquifer thickness [m]*
Riccarton Aquifer	50	15-25
Linwood Aquifer	90	30
Burwood Aquifer	105	10

Table 5.1 Depth of the Aquifer bottom and Aquifer thicknesses for Aquifer 1-3, respectively.

5.6.2 Aquifer parameters

The required aquifer parameters to run the model are:

1) Hydraulic conductivity
2) Leakance
3) Specific storage
4) Porosity

In this study only a steady-state run was conducted. In the steady-state run, values for specific storage and porosity should be small in order to accelerate the movement of the interface. The steady-state solution is independent from porosity or specific storage. In the transient run however, realistic values should be used.

The values for hydraulic conductivity were obtained from a summary of pump test results for each aquifer (see Chapter 3) from CRC (1997a). Hydraulic conductivity data for Aquifer 2 and 3 were scarce. Therefore the mean transmissivities (403m^2/day and 1726m^2/day, respectively) were divided by the mean thickness of the aquifers which were used in the model to obtain the hydraulic conductivities. This is acceptable because the saturated thicknesses of Aquifer 2 and 3 remain steady in the model. A representative data set of hydraulic conductivity existed for Aquifer 1 in this area and the mean hydraulic conductivity (132m/day) as opposed to the mean transmissivity value was taken from CRC (1997a). Aquifer hydraulic conductivity was set constant in the model and so not used as a calibration tool.

Leakance values were obtained from pump tests, which had been conducted on wells within the confined aquifers (see Section 3.3). There were only very few data concerning leakance of the aquitards. Table 5.2 summarises the aquifer parameters that were used in the model.

Aquifer	*Hydraulic conductivity (m/s)*	*Porosity (%)*	*Specific storage (m)*	*Leakance of overlying aquitard (s^{-1})*
Riccarton Aquifer	1.5×10^{-3}	1.0×10^{-4}	0	3.6×10^{-8} -8.1×10^{-10}
Linwood Aquifer	1.5×10^{-4}	1.0×10^{-4}	0	2.4×10^{-10}
Burwood Aquifer	2.0×10^{-3}	1.0×10^{-4}	0	9×10^{-10}

Table 5.2 Aquifer parameters used in the model

5.6.3 Boundary conditions

The model allows the simulation of prescribed flux boundaries, constant freshwater and/or saltwater head boundaries, and leaky head dependent boundaries in the top aquifer.

No flow boundaries are specified by a freshwater hydraulic conductivity of zero in the x-direction. No flow boundaries represent groundwater flow lines, inferred from the potentiometric contours. In order to prevent recharge to, or discharge from the system, the cells which define the outer boundaries of each layer were assigned a freshwater hydraulic conductivity of zero.

The freshwater head seaward boundary, which represents the outcrop of the Riccarton Aquifer, was assigned negative values to fix the freshwater heads. In order to simulate the uppermost aquifer outcrop, the cell which represents the outcrop was given a higher leakance value.

A constant head boundary was used to represent throughflow from the west to the confined aquifer system.

5.6.4 Leakage conditions

Two different leakage conditions can be simulated with SHARP (ESSAID, 1990a):

1. Complete mixing when leakage of freshwater into saltwater and vice versa is small and mixing occurs instantaneously.
2. Restricted mixing when vertical flow and leakage are considerably high the model simulates that no seawater leaks into freshwater. Leaking freshwater is distributed between overlying freshwater and saltwater zones depending on the quantity of freshwater in the overlying block.

In this study the restricted mixing method has been used as suggested by ESSAID (1997, *pers .comm.*). It gives a more conservative position of the interface than the complete mixing method.

5.7 Model calibration

After determining the aquifer parameters the model is calibrated by trial and error. The aquifer parameters are adjusted until the heads calculated by the model closely match the observed values. The model has been calibrated to the mean potentiometric head distribution of Aquifer 1 in the simulated cross-sectional area (see Appendix D.1) and an approximate head distribution for Aquifer 2 and 3. Data for the potentiometric head distribution of Aquifer 2 and 3 were very sparse in the simulated cross-sectional area (see Appendix D.2 and D3). The model input data is given in Appendix D.4.

Model calibration was carried out by varying aquitard leakance. A uniform aquitard leakance value was used for each layer (see Appendix D.4).

Figure 5.8 shows the head distribution of Aquifer 1, 2 and 3 in the onshore part of the model and the real mean head distribution of Aquifer 1. The fit between the simulated and realistic head distribution is very good. The model output data is given in Appendix D.5. The mass balance (Appendix D.5) was checked for model calibration. The model was also examined on whether the flow through the system seemed realistic.

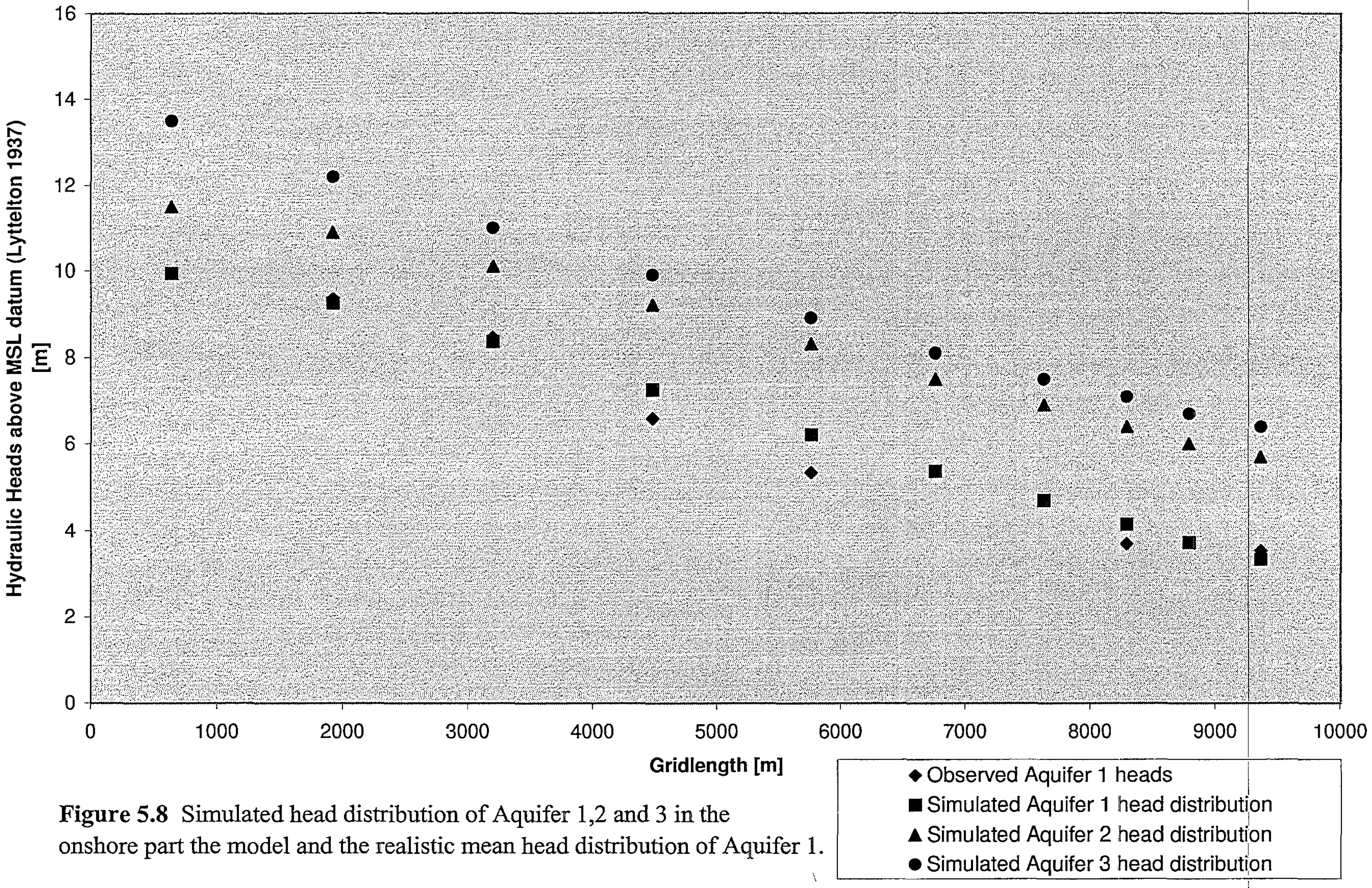


Figure 5.8 Simulated head distribution of Aquifer 1,2 and 3 in the onshore part the model and the realistic mean head distribution of Aquifer 1.

5.8 Sensitivity analysis

A sensitivity analysis was conducted on the model. Hydraulic conductivity of Aquifer 1 and leakance of the uppermost aquitard were varied by factors of 2 and 0.5. As a result the modelled head distributions of the aquifers were kept within a reasonable range to simulate realistic data. However, the interface position moved up to about 6km as aquifer hydraulic conductivity and aquitard leakance were varied (see Appendix D.6 and D.7). This indicates that the result of the modelling exercise is not very reliable and that it should be treated with care.

The model was not very sensitive to whether or not Aquifer 1 cropped out at 40km offshore (see Appendix D.8). This shows that the interface position is likely to be dominated by offshore leakage of overlying seawater through the uppermost confining layer, not by lateral inflow of seawater through the offshore outcrop.

5.9 Model restrictions

The model results are dependent on the accuracy of the field data available and the degree to which the model approaches reality. Some model limitations that should be taken into account regarding the results of the modelling exercise are outlined here:

- In SHARP, Darcy's Law for density-dependent flux is used to determine vertical leakage between aquifers. However, this led to leakage schemes that were inconsistent with the key sharp interface (immiscible fluids) modelling assumptions (HYAKORN, *et al.* 1996).
- The model area has been separated from the Central Plains by no flow boundaries. However, both belong to one large groundwater system.
- Limitations in quantity and quality of the available data are reflected in the modelling outcome.
- Sharp is calibrated to the potentiometric head distribution of the aquifer system. However, the freshwater head distribution offshore is unknown.
- Salinity-dependent changes in hydraulic conductivity are neglected.

5.10 Results

According to modelling results the freshwater/seawater interface of Aquifer 1 is located at about 3.3km offshore within the simulated cross-sectional area (see Figure 5.7). The freshwater/seawater interface within Aquifer 2 is located at about 17.5km offshore. However, a sensitivity analysis conducted on the model indicated that the modelling results should be treated with care. To verify the modelling results the freshwater/seawater interfaces within Aquifer 1 and 2 were calculated by extending the freshwater hydraulic gradients and the aquifers offshore. The intersection of the freshwater/seawater interfaces with the middle of the aquifers was calculated from the Ghyben/Herzberg relationship. Aquifer 1 is about 15m thick. The top of the aquifer lies at about 40m depth below sea level at the shoreline within the simulated cross-sectional area (see Figure 3.7). The aquifer slopes with a gradient of approximately 0.002. The hydraulic gradient of Aquifer 1 heads in the cross-sectional area is about 0.0007. The mean hydraulic head at the shoreline is 3.54m. This suggests that the interface within the middle of Aquifer 1 is located at a depth of 53.7m at 3100m offshore.

Aquifer 2 is about 30m thick. The top of the aquifer lies at about 70m depth below sea level at the shoreline within the cross sectional area (see Figure 3.9). The aquifer slopes with a gradient of approximately 0.0015. The hydraulic gradient of Aquifer 2 heads in the cross-sectional area is about 0.00064. The hydraulic head of the aquifer at the shoreline was calculated to be around 5m. This suggests that the interface within the middle of Aquifer 2 is located at a depth of about 91.45m at 4250m offshore.

5.11 Conclusions

According to the Sharp steady-state simulation of the freshwater/seawater interface in a 50km long and 1km wide cross-sectional model, across the confined region of the Christchurch artesian aquifer system, the location of the freshwater/seawater interface within Aquifer 1 is located at about 3300m offshore. This result is reasonably compatible with the calculation of the interface location at 3100m offshore within the same cross-sectional area in Aquifer 1, using the Ghyben-Herzberg relationship. The modelling result therefore seems to be within a realistic range for Aquifer 1.

The aquifer properties of Aquifer 2 and 3 are only poorly known and the aquifers have been calibrated to realistic, but not to real hydraulic heads due to insufficient data. The simulated freshwater/seawater interface location within Aquifer 2 has been calculated to be located at about 17.5km offshore. However, according to the calculation using the Ghyben-Herzberg relationship the interface is located at about 4.25km offshore. Hence the modelling outcome for the interface location of Aquifer 2 and 3 involves a high degree of uncertainty and should be treated with caution.

It is important to consider that the model represents steady-state. In reality the interface is continually responding to changes in water levels. Only a cross-sectional area has been represented. Since water levels in Christchurch vary spatially the interface position will also vary. For example, water levels decrease toward Banks Peninsula, therefore the interface location is expected closer to the coast near Banks Peninsula than in the simulated area.

The conceptual model by TALBOT *et al.* (1986) is not realistic. The modelling study indicated that the interface position is likely to be dominated by offshore leakage of overlying seawater through the uppermost confining layer, not by lateral inflow of seawater through the offshore outcrop.

5.12 Recommendations

From the authors point of view it is not recommended to expand the SHARP model. The model easily becomes unstable. It is also difficult to use. It is suggested instead to determine the location of the freshwater/seawater interface by expanding the freshwater hydraulic gradient and the slope of the aquifer offshore and to calculate the interface depth by using the Ghyben-Herzberg relationship. In this study this approach seemed equally meaningful as the modelling approach and was a lot less time consuming. To predict the behaviour of the freshwater/seawater interface it is recommended to use a more reliable model such as the MODFLOW (MCDONALD and HARBAUGH, 1988) or the Visual MODFLOW software package (GUIGER and FRANZ, 1996) to predict future groundwater levels. The interface position can then be determined from the Ghyben-Herzberg relationship.

6 Management strategies

6.1 General

The long-term management of a groundwater resource is best focused on the prevention of adverse environmental conditions rather than on remediation or abandonment of a polluted area. The restoration of an already polluted aquifer involves significant expense and may be ongoing for years.

The objective of this chapter is to suggest aquifer management strategies to remediate groundwater contamination in the study area and to prevent seawater intrusion into the Christchurch artesian aquifer system in the future. Computer modelling is used as a tool to predict the reaction of the Christchurch artesian aquifer system to future stresses and to obtain a better understanding of the groundwater dynamics in the study area. The simulated management scenarios should be treated with caution. They may indicate how the system works but do not provide an absolute answer.

A groundwater level and quality monitoring network has been set up in the study area. This will facilitate ongoing study of the behaviour of the "real" (opposed to "modelled") system. This monitoring network will also allow an assessment of whether the suggested management strategies are efficiently remediating adverse environmental effects.

6.2 Construction of a groundwater level and quality monitoring network in the study area

During this investigation, significant gaps within the groundwater-monitoring network in the study area were identified. There was an attempt to locate more wells in the study area which could provide important information on groundwater quality and water levels. The search was focused on finding shallow wells into the confining layer close to Aquifer 1 wells, to determine the vertical hydraulic gradient between the aquifers. This search for wells was unsuccessful, so that it was impossible to establish the vertical hydraulic gradient in the study area. Wells for which limited information had been recorded on the Canterbury Regional Council database could not be located; many having been sealed and/or over covered by roads and buildings.

Therefore, a groundwater-monitoring network extending from the estuary into the Heathcote Valley was designed and constructed during this study. An Aquifer 1 bore was drilled (well no: M36/5325) on "The Great Green Planting Machine" reserve on Humphrey's Drive near the estuary (see Figure 6.1) to allow the monitoring of the vertical hydraulic gradient between the estuary, the uppermost confining layer, and Aquifer 1. Clemence Drilling Contractors Ltd. drilled the well in November 1997 (for consents see Appendix E.1; for borelog see Appendix E.2). A shallow, 6m deep piezometer was installed next to the new Aquifer 1 well on Humphrey's Drive (well no: M36/5385). Piezometer installation was undertaken in co-operation with the Christchurch City Council. Monitoring of estuarine water levels is conducted by the Christchurch City Council at Ferrymead Bridge (see Figure 6.1) (contact: Derrick Carver).

Shallow 6m deep piezometers (well no: M36/5384 and M36/5570) were also installed next to the Aquifer 1 wells M36/1159 on Scruttons Road and next to M36/1917 on Chapmans Road (see Figure 6.1) in December 1997 to enable monitoring of the hydraulic gradient in the area.

Water level data obtained from the Aquifer 1 well and the 6m deep piezometer at Scruttons Road, and from the estuary at Ferrymead Bridge, between the end of December 1997 and May 1998, is plotted on a graph in Appendix E.3. The data indicates that the hydraulic gradient between the estuary, the confining layer, and Aquifer 1 is mostly directed downward at this site.

At Humphrey's Drive, a first water level measurement, taken on 16/12/97, indicated a downward hydraulic gradient of -0.012 between the shallow well and the Aquifer 1 well. Long-term water level monitoring equipment was installed on 19/12/97. The water level data obtained since that time indicate that the aquifer system recovered over the Christmas period resulting in a mostly upward hydraulic gradient during this time (see Appendix E.4). It is likely that this was related to reduced water abstractions in the area due to the public holidays, with industries turning off their wells and residents being away on vacation. However, by the end of January water abstraction in the area increased resulting in an immediate water level decline in Aquifer 1. Consequently the hydraulic gradient between the estuary, the uppermost confining layer, and Aquifer 1 was sometime directed downward after high tides (see Appendix E.4).

When the Aquifer 1 well on Humphrey's Drive (well no.: M36/5325) was drilled, a strong hydrocarbon odour was detected from the sediment within the top 6m. Water samples were collected at 12m and 18m depth during the drilling process. In order to avoid contamination of the sampled water, pneumatic rotary drilling was chosen and a non-hydrocarbon bearing lubricant was used to screw the sections of well casing together. After the well was developed, groundwater samples were taken from the Aquifer 1 well and from the 6m deep well. Trace metals were collected in prepared bottles dosed with acid. Organic compounds were collected in glass bottles with a teflon foil insert in the cap. Bottles, which were used to collect inorganic determinands, were rinsed three times with the water being sampled. The samples were analysed by Standard Telarc-accredited analytical methods. Table 6.1 indicates the chloride concentrations of groundwater from different depths at the site at Humphrey's Drive. Groundwater from Aquifer 1, at 33m depth, exhibited chloride concentrations of 4mg/l indicating that seawater is absent. The water quality data (see Appendix E.5) showed that up to 18m depth ion concentrations, for ions which are typically present in seawater, increased with depth, whereas ion concentrations of ions which are typically present in landfill leachate decreased.

Well no	*Collection date*	*Depth [m]*	*Cl^- [mg/l]*
M36/5385	12/2/98	6	1980
M36/5325*	3/11/98	12.35	13000
M36/5325*	3/11/98	18.3	13000
M36/5325	12/2/98	33	4

Table 6.1 Chloride concentrations of groundwater from different depths at the site at Humphrey's Drive.

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*Samples taken during drilling process.

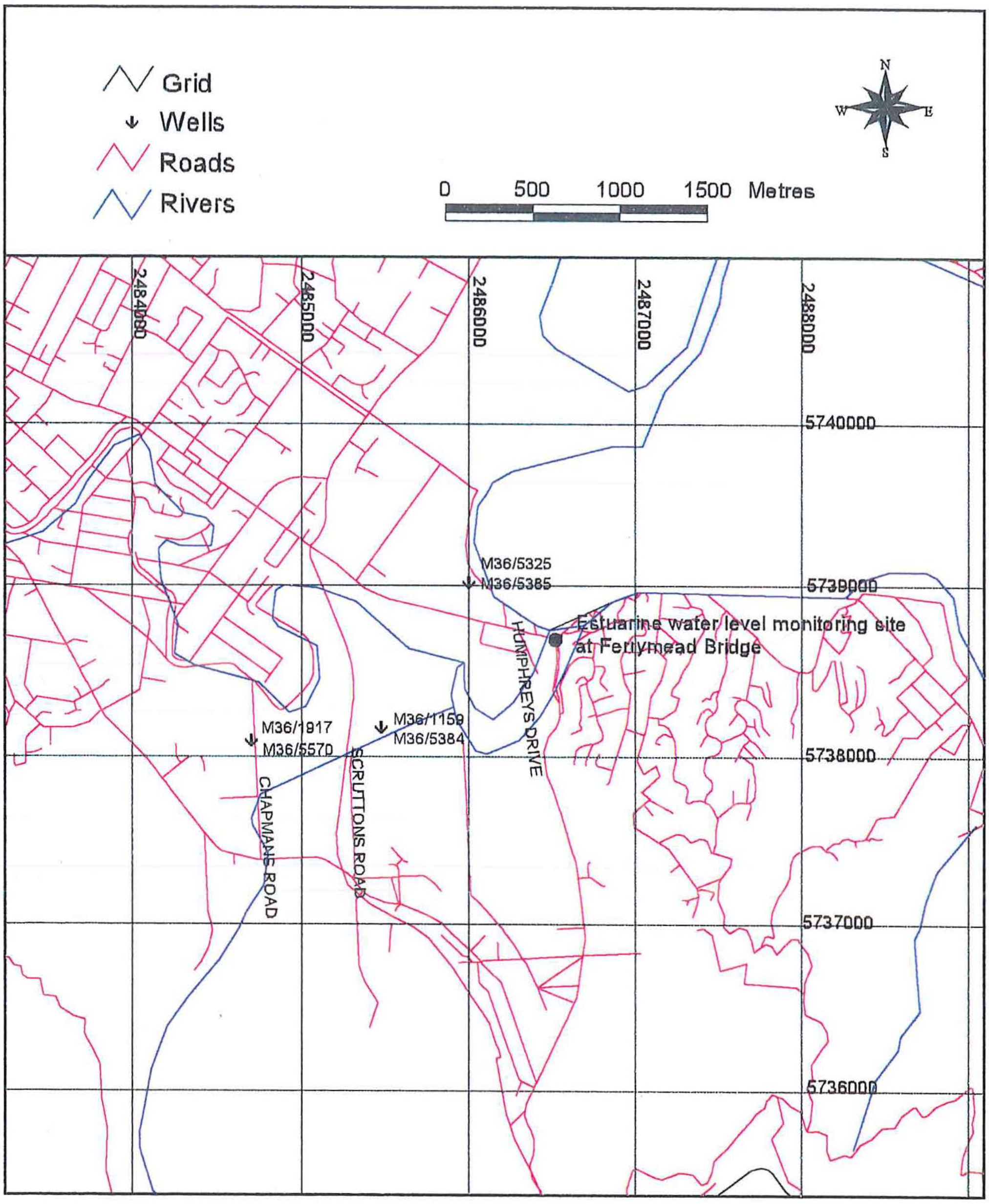

Figure 6.1 Location of the constructed water level and quality monitoring network in the study area.

6.3 Predicting seawater intrusion into the Christchurch artesian aquifer system via groundwater modelling work

During the past few years a groundwater flow model has been constructed by Dave Scott from Canterbury Regional Council as part of the Christchurch-West Melton groundwater investigation (CRC, 1997). The model has been used to simulate the variation of groundwater levels and spring-fed stream flows as a function of estimated groundwater recharge and abstraction throughout the Christchurch-West Melton area. The model was constructed using the three-dimensional finite-difference USGS model MODFLOW software package (McDONALD and HARBAUGH, 1988) and has been based on the hydrogeological information, summarised by TALBOT *et al.* (1986). It consists of 5 layers, which represent the aquifers underlying the area. The aquitards are represented by leakage terms. The information on aquifer and aquitard thicknesses was obtained from the CRC well database. Aquifer and aquitard properties have been adjusted to simulate observed groundwater level fluctuations and stream flows over the past 31 years (SCOTT, 1996). Some preliminary work has been conducted to assess the potential of the model to predict future scenarios. These simulations have been based on two alternative demand options and 3 alternative future climate patterns. The demand options were (SCOTT, 1996):

1. Demand stagnates at the level reached by the end of 1994/95.
2. Demand grows at the same rate estimated over the past three decades.

The climate pattern options were (SCOTT, 1996):

1. A repetition of the last 31 years of rainfall & evapotranspiration, which began with a relatively dry decade.
2. A repetition of the last 31 years but with the drier decade delayed by 10 years.
3. A repetition of the last 31 years but with the drier decade delayed by 20 years.

The simulations for the six scenarios showed that, if a dry decade is encountered in the nearest future, water levels are expected to drop below minimum-recorded water levels independently of growth in water demand. However, the most adverse future effects were encountered when demand grew and the dry period occurred toward the end of the simulation period (SCOTT, 1996). Figure 6.2 shows a potentiometric contour plot of

Aquifer 1 in July 2026 under these conditions. According to the modelling outcome water levels would drop below sea level within an extensive area around the Estuary of the Avon and Heathcote Rivers. Contamination of the groundwater in that area, by seawater and contaminants from the surface, would be the consequence.

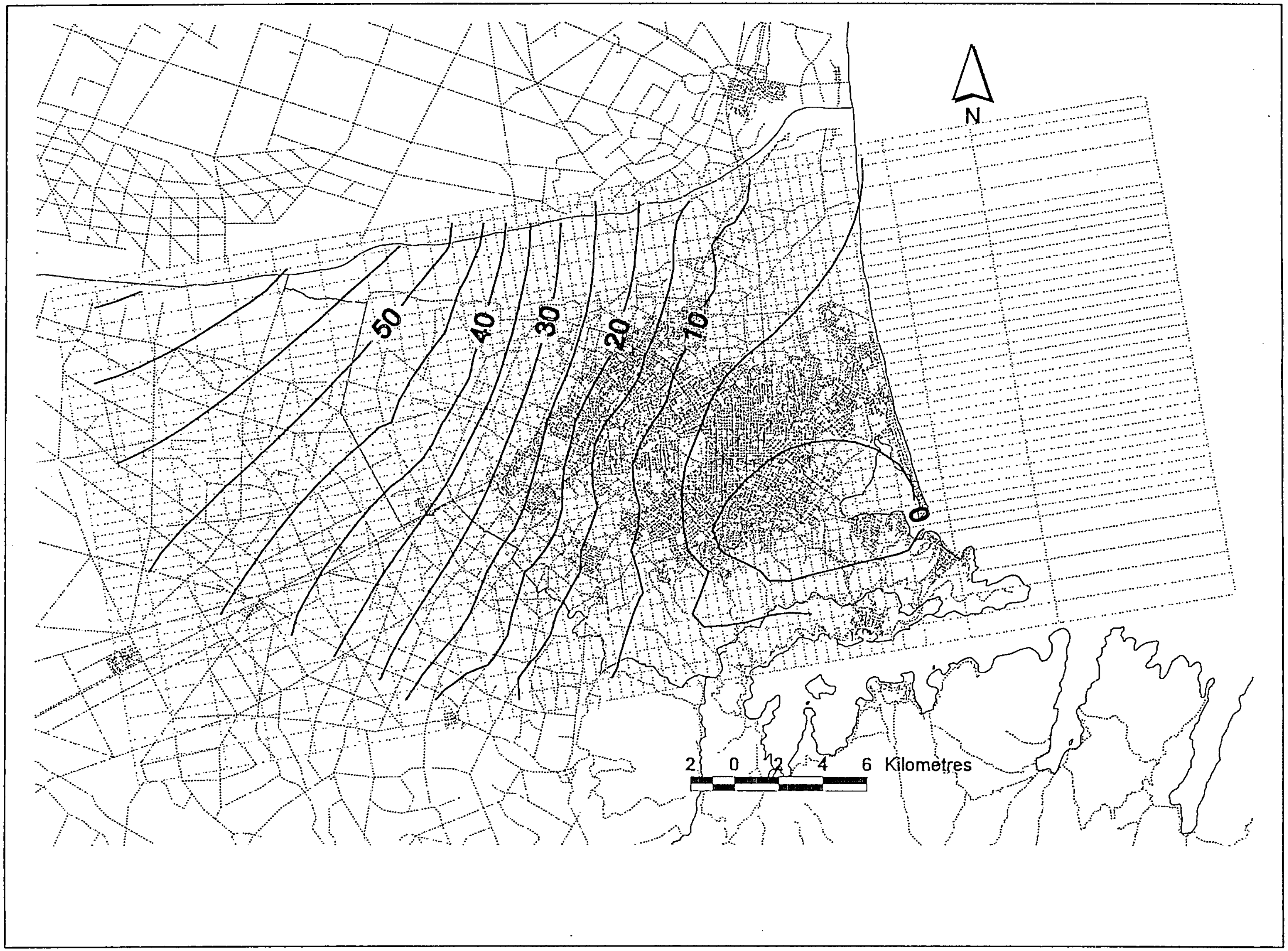

Figure 6.2 Low computed Aquifer 1 groundwater levels for climate pattern 3 and demand scenario 2 (from DAVE SCOTT, 1996).

6.4 Construction of a groundwater model specific to the Woolston/Heathcote area to facilitate groundwater management

6.4.1 Introduction

A groundwater flow model specific to the study area has been constructed, using the Visual MODFLOW software package (GUIGER and FRANZ, 1996). The model has been calibrated to the potentiometric survey of the study area conducted in March 1997. The purpose of the model was to simulate changes of water levels in the study area in response to various management scenarios and to define groundwater flow paths using MODPATH. It was hoped to investigate the potential of the model to explore groundwater contamination scenarios that occur in the study area.

6.4.2 Model selection

For this study a fully integrated package, which combines MODFLOW, MODPATH, and MT3D in three-dimensions was used (GUIGER and FRANZ, 1996). The modelling software was chosen because it is widely used and well established. MODFLOW was used to explore the aquifer response to different management regimes. In addition it was intended to use the MODPATH software for the definition of groundwater flow paths to investigate seawater intrusion and landfill leachate as possible contaminant sources. The integration of a groundwater flow and a contaminant transport model leaves potential to expand the model application.

6.4.3 Model structure

The groundwater model has been based on the geology and hydrogeology outlined by CRC (1997). The horizontal model grid is illustrated in Figure 6.3. It covers 240km^2 of the eastern confined area of the aquifer system in the south-east of Christchurch City. The model grid consists of 30x32 cells, each 500m long and wide. It consists of 5 layers. Layer 1 and 2 represent Aquitard 1 (the uppermost aquitard), layer 3 represents Aquifer 1, layer 4 Aquitard 2 (the aquitard beneath Aquifer 1), and layer 5 Aquifer 2, respectively. The layer thicknesses were obtained from 62 wells from the CRC database.

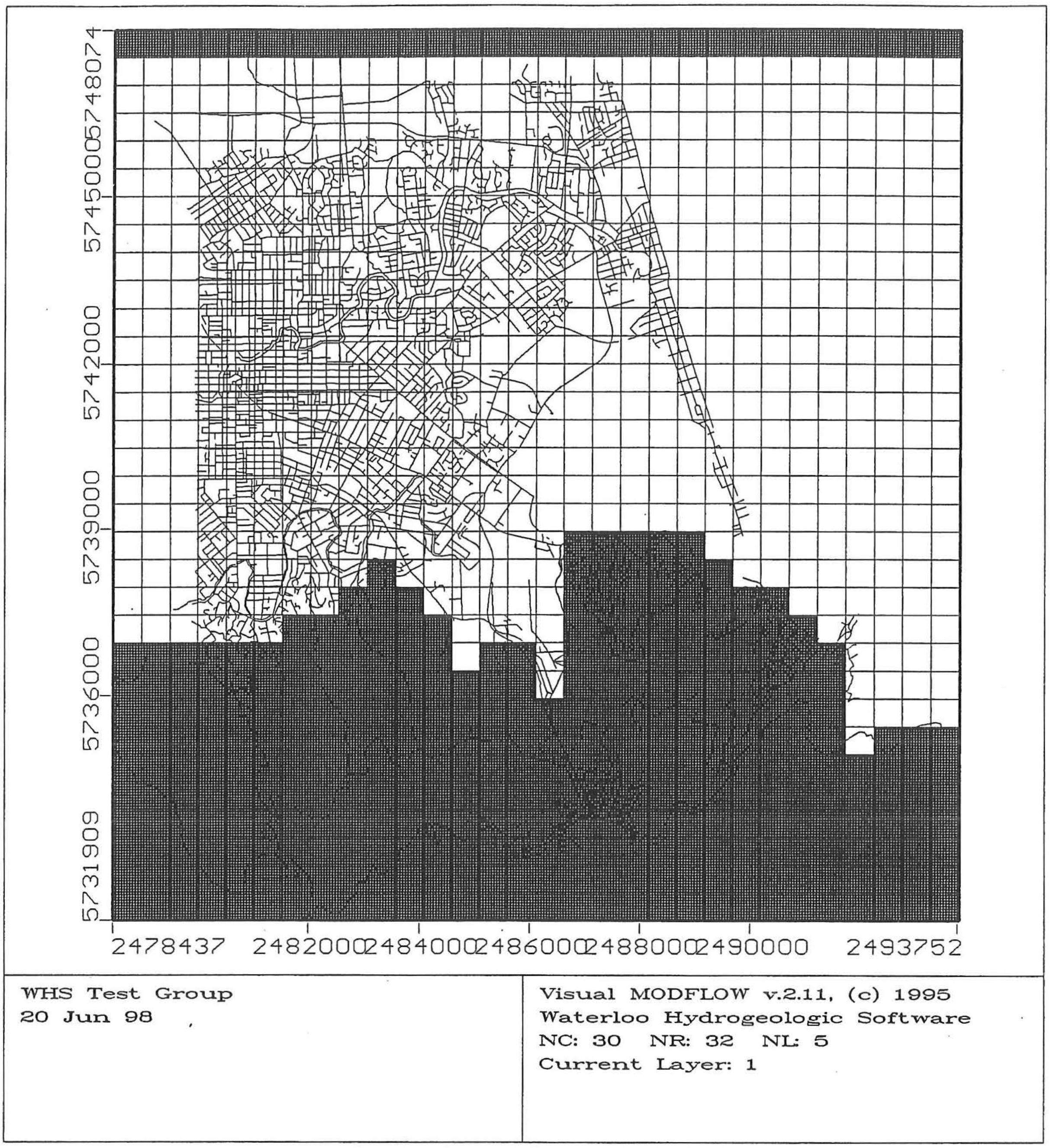

Figure 6.3 Woolston/Heathcote area grid.

6.4.4 Boundary conditions

By default the model is surrounded by no flow boundaries. The area, which represents Banks Peninsula volcanic rock, acts as no flow boundaries, since the lithologies are believed to be of relatively low hydraulic conductivity. One model cell, which coincides with the location of the volcanic seastack identified by WEEBER (1993), is inactivated in Aquifer 1 and 2. In the Heathcote Valley Aquifer 2, and the overlying confining strata have also been inactivated, as Aquifer 2 is partly missing in this area (WEEBER, 1993). The starting head arrays are given in Appendix F.1

Constant head boundaries have been assigned in Aquifer 1 and 2 in the offshore area to represent the freshwater/seawater interface (Appendix F.1).

Aquifer throughflow to the west is simulated via wells at the western boundary of the model. Upwards leakage from Aquifer 3 to Aquifer 2 is represented by Aquifer 2 recharge wells located in every grid cell (Appendix F.2).

In contrast to Dave Scotts model the Avon and the Heathcote rivers are represented as constant head cells (Appendix F.1). Discharge to these rivers occurs via upward seepage through the confining layers. This is believed to be important, as NOBI and DAS GUPTA (1997) showed that for an unconfined aquifer system the dynamic interaction between the rivers and the aquifer system significantly influenced the flow and the salinity intrusion in both systems. This is likely to also apply for a confined aquifer system. Groundwater abstractions may reduce recharge to the river. A smaller discharge of groundwater to the river may result in an increasing salinity of the estuary and the river, allowing saline water to intrude further inland.

6.4.5 Initial aquifer and aquitard parameter estimates

The following aquifer and aquitard parameters are required to run MODFLOW:

- Hydraulic conductivity
- Specific yield
- Specific storage
- Porosity

Only hydraulic conductivity is used in the steady-state model. Initially each of the parameters was set constant for each layer in the model. Table 6.2 summarises the initial aquifer and aquitard parameters in the model. Throughflow from the west and recharge via upward seepage from Aquifer 3, was initially calculated by Darcy's law:

$$Q = -KA\frac{dh}{dl}$$

where: Q = discharge [m^3/sec]

$\frac{dh}{dl}$ = hydraulic gradient [m/m]

A = area [m^2]

K = hydraulic conductivity [m/sec]

The aquifer and aquitard parameters of the calibrated model are given in Appendix F.3.

	Hydraulic conductivity [m/s]	Reference	Specific storage	Reference	Specific yield	Reference	Porosity	Reference
Aquitard 1	$4x10^{-7}$	Dave Scott's MODFLOW model	$3.7x10^{-6}$	FREEZE and CHERRY (1979) give a range of 0.005-0.00005 for a confined aquifer. Here the intermediate value was devided by average thickness	0.18	FETTER (1988, Table 4.3, p. 74)	0.4	DOMENICO and SCHWARTZ (1990)
Aquifer 1	$7x10^{-4}$	Mean of pump test on wells M35/6107 and M36/0979 LITTLE (1997)	$1.9x10^{-4}$	Mean storage of pump test on wells M35/6107 and M36/0979 devided by mean thickness LITTLE (1997)	0.25	FETTER (1988, Table 4.3, p. 74)	0.25	DOMENICO and SCHWARTZ (1990)
Aquitard 2	$4.05x10^{-8}$	Dave Scott's MODFLOW model	$3.7x10^{-6}$	As Aquitard 1	0.18	FETTER (1988, Table 4.3, p. 74)	0.40	DOMENICO and SCHWARTZ (1990)
Aquifer 2	$1.7x10^{-4}$	Mean of pump test on wells M36/4578 and M36/4595 LITTLE (1997)	$3.7x10^{-6}$	Storage of pump test on well M36/4578 devided by thickness LITTLE (1997)	0.25	FETTER (1988, Table 4.3, p. 74)	0.25	DOMENICO and SCHWARTZ (1990)

Table 6.2 Initial aquifer and aquitard parameters in the model.

6.4.6 Calibration process

A steady-state calibration of the groundwater flow model in the Woolston/Heathcote area has been undertaken. The water level data obtained from the potentiometric survey in March 1997 was used as the calibration target for the steady-state model. The long-term water level data in the study area indicated that the potentiometric survey was representative of mean water levels in this area. Long-term groundwater abstraction wells, owned by the City Council and by local industries, were integrated in the model. Fortunately relatively accurate abstraction records were available for the wells in the area.

The model calibration was carried out by trial-and-error adjustment of the hydraulic conductivity and conducted in several steps:

1. As Aquifer 2 was calibrated, Aquifer 1 cells were set as constant head boundaries in the model. The Aquifer 1 hydraulic head data from the potentiometric survey was used for this.
2. To replicate the observed potentiometric contour lines bending around the estuary, it was necessary to increase the hydraulic conductivity of Aquitard 2 from the initial value of 4.05×10^{-8}m/s to 1.05×10^{-7}m/s. This increased hydraulic connection between Aquifer 1 and 2 was necessary, to simulate the mirrored potentiometric contour pattern between Aquifer 1 and Aquifer 2.
3. Recharge from the underlying Aquifer 3 was adjusted to achieve a closer match to observed water levels.
4. To achieve a reasonably good match between observed and simulated hydraulic heads, three zones of Aquifer 2 hydraulic conductivity's in the range of 4×10^{-4} to 1×10^{3}m/s were introduced.
5. Once Aquifer 1 was calibrated, the simulated Aquifer 2 water level data was used to set Aquifer 2 cells as constant head boundaries.
6. Again difficulties arose in simulating the observed bend of Aquifer 1 potentiometric contour lines around the estuary. It is suspected that this spatial change in the groundwater flow pattern is a function of groundwater discharge by upward seepage through the estuary. A better match was therefore attempted by increasing the hydraulic conductivity of Aquitard 1 in the estuary. However,

this led to unrealistically low heads at South New Brighton Spit and so this approach was disregarded. A better match was obtained by decreasing the hydraulic conductivity of Aquitard 1 along the shoreline.

Although well logs indicate that the sediment of Aquitard 1 along the New Brighton Spit shoreline is coarser than further landward, well logs indicate a peat layer, often occurring just above Aquifer 1, in this area. This peat layer may justify the lower hydraulic conductivity of Aquitard 1 along the New Brighton Spit shoreline.

7. To match the pattern of the observed Aquifer 1 potentiometric contour lines closely, 5 zones of differing hydraulic conductivity, ranging from 1.5×10^{-4} to 3×10^{-3}m/s (the initial value was 7×10^{-4}m/s) were introduced in Aquifer 1.
8. Finally recharge via the throughflow wells at the western boundary of the model and the hydraulic conductivity of Aquitard 1 was adjusted to obtain a reasonable match between observed and simulated hydraulic heads.

6.4.7 Results

Figure 6.4 and 6.5 show the match between the observed potentiometric contour lines obtained from the survey in March 1997 **(bolded)** and the potentiometric contour lines calculated by the model (regular) for Aquifer 1 and 2. The mean error between the modelled and observed heads for Aquifer 1 and 2 wells is 0.18, the mean absolute error is 0.72, and the RMS error is 0.92. Note: it should be considered that the hydraulic heads calculated by the model always represent the mean hydraulic heads of the cells in which the wells are located whereas the observed hydraulic heads derive from a specific site. Also, the errors which are involved in potentiometric surveying should be considered. The Heathcote Valley has been focussed on in this model, as this is where the lowest groundwater levels are experienced. The match between measured and simulated hydraulic heads of wells in the Heathcote Valley is shown in Table 6.3. For well locations see Figure 4.6.

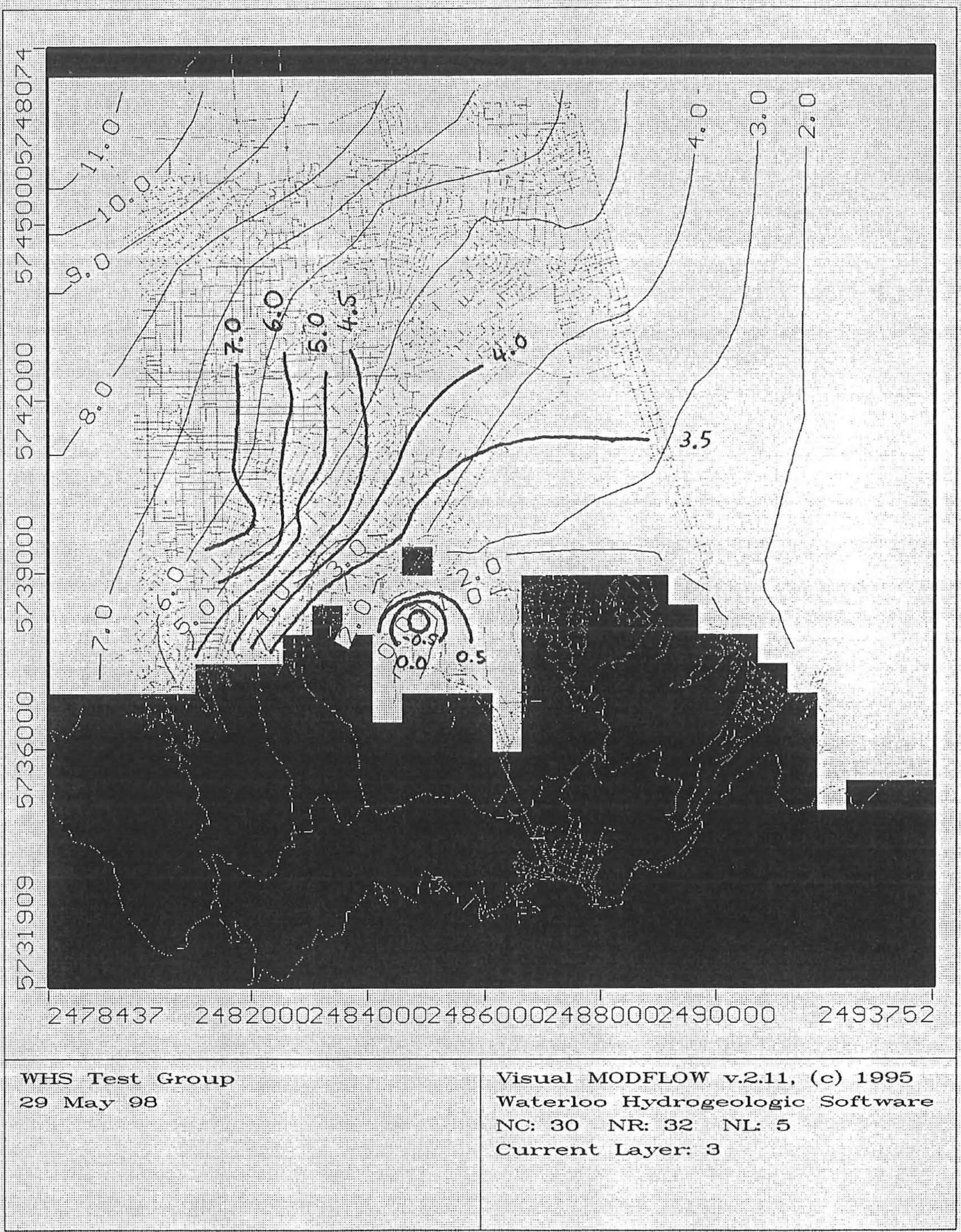

Figure 6.4 Match between simulated (regular) and observed **(bolded)** Aquifer 1 potentiometric contour lines in metres above the Lyttelton 1937 datum.

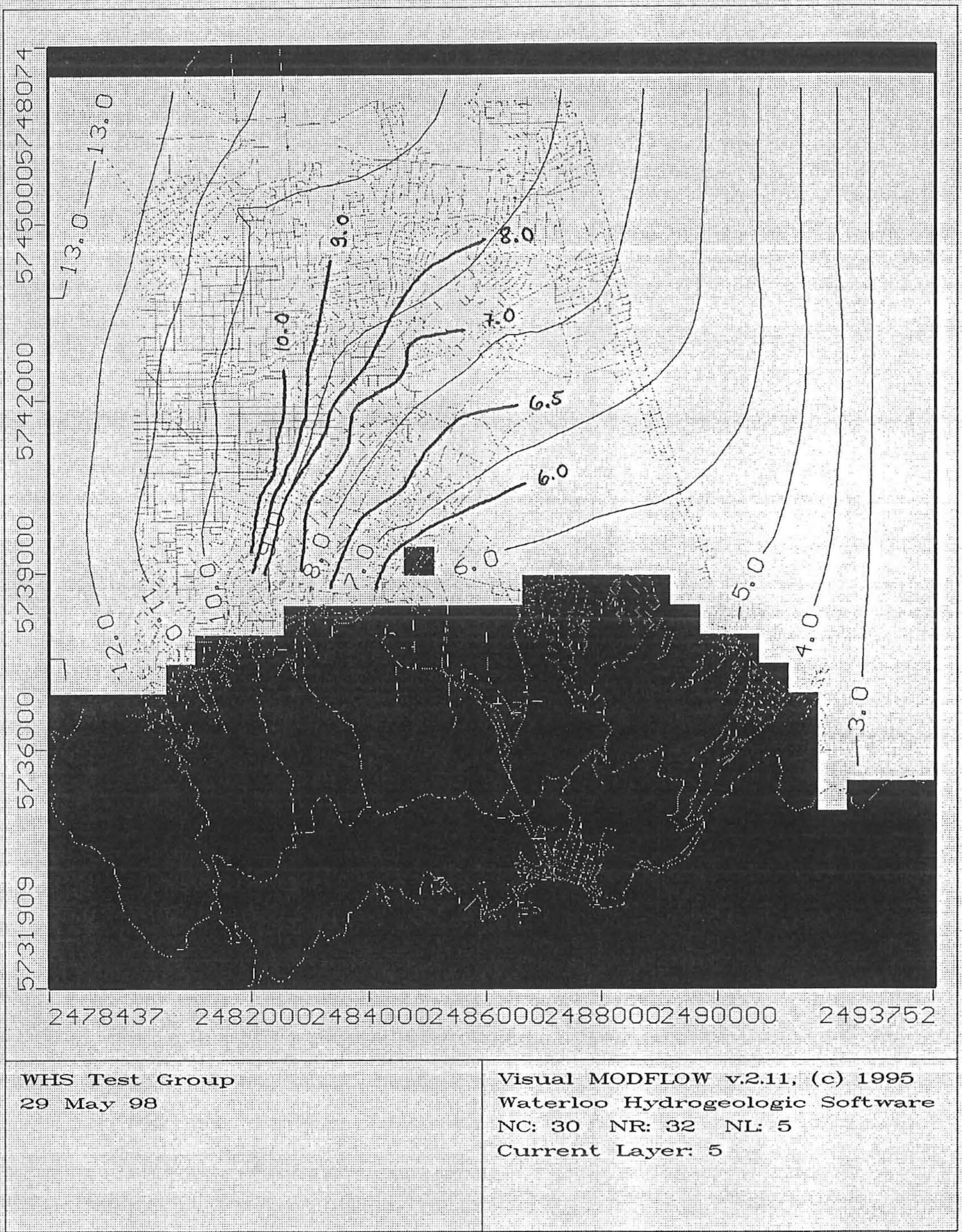

Figure 6.5 Match between simulated (regular) and observed **(bolded)** Aquifer 2 potentiometric contour lines in metres above the Lyttelton 1937 datum.

Well no	*Calculated head [m above the Lyttelton 1937 datum]*	*Observed head [m above the Lyttelton 1937 datum]*
M36/1160	0.24	0.42
M26/1159	0.41	0.16
M36/1158	-0.20	-0.36
M36/1917	-0.83	-0.65
M36/4906	-0.83	-0.85

Table 6.3 Match between calculated and observed heads from wells in the Heathcote Valley.

6.4.8 Mass Balance

A comparison of the mass balance of the model with calculated data and field data is noted below.

INPUTS

Flow from recharging wells at western boundary for:	*Model [m/s]*	*Initial calculations [m/s]* $Q=-T\,width\,\frac{dh}{dl}$
Aquifer 1	0.40	$0.035m^2/s$ 10,500m 0.001=0.36
Aquifer 2	0.21	$0.0046m^2/s$ 10,500 0.0027=0.13

Upwards leakage from underlying layers for:	*Model [m/s]*	*Initial calculations [m/s]* $Q=-K\,A\frac{dh}{dl}$
Layer 1	0.42	
Layer 2	2.5	
Layer 3	2.9	$1.5\ 10^{-7}m/s\ 1.46\ 10^8m^2\ 2/10$=4.4
Layer 4	2.9	
Layer 5	3.2	$4\ 10^{-8}m/s\ 1.45\ 10^8m^2\ 2/5$=2.3

OUTPUTS

Flow to coastal boundary:	*Model [m^3/s]*	*Daves model*[1] *(Dave Scott, 1998, pers.comm.) [m^3/s]*
Aquifer 1	0.57	
Aquifer 2	0.46	
All aquifers	1.02	1.6

Flows to drains:	*Model [m^3s]*	*Estimated [m^3s]*	*Source*
Heathcote River	0.48	0.5	Stream baseflows from TALBOT *et al.* (1986)
Avon River	0.75	1.7	Stream baseflows from TALBOT *et al.* (1986)
Estuary	1.3	16.3	Compared with the average seepage rate of 0.014l/m/m^2 for Lake Ellesmere to the south of Banks Peninsula (ETTEMA and MOORE 1995)

Wells:	*Model [m^3/s]*	*Source*
Aquifer 1	0.23	actual usage data from CRC database
Aquifer 2	0.1	actual usage data from CRC database

Upwards leakage:	*Model [m^3/s]*	*Initial calculations [m^3/s]* $Q=-KA\frac{dh}{dl}$
Layer 2	0.42	
Layer 3	2.5	1.5 10^{-7}m/s 1.46 10^8m^2 2/10=$\underline{4.4}$
Layer 4	2.9	
Layer 5	2.9	

Table 6.4 Mass Balance of the MODFLOW model, specific to the Woolston/Heathcote area.

In general the modelled data compare reasonably well with the calculated data. However, differences between the modelled and field data are outlined as follows:

- The model inputs into the Heathcote River appear slightly high.

[1] Dave Scotts Christchurch-West Melton Area model is approx. 2/3 wider and comprises 5 aquifers.

- A comparison of seepage data obtained from Lake Ellesmere indicates that the model may underestimate the amount of water, which leaves the system via upward seepage through the estuary.

6.4.9 Simulated management strategies

It was intended, to use the model to address the following issues:

- To explore the response of the aquifer system to pumping restrictions imposed on the pumping wells in the Woolston/Heathcote area.
- To investigate the response of the aquifer system to the relocation of abstractions from wells within the study area.
- To simulate artificial recharge in the area, if pumping restrictions or the relocation of the abstraction sites are not sufficient to address saltwater intrusion effects.

At this stage it is believed that the model needs further development to address the last two issues. However, the response of the aquifer system to pumping restrictions in the Woolston/Heathcote area has been investigated. According to model simulations, if pumping ceases from Aquifer 1 wells in the Woolston area (including M36/1187, M36/1013, M36/2204, M36/1004, M36/1014, M36/1014, M36/1045, and M36/2244) there is very little effect on the low hydraulic heads in the Heathcote Valley. In contrast, pumping restrictions, imposed on the two wells in the Heathcote Valley (M36/1163 and M36/1072), increased water levels in the area of low hydraulic heads to a greater extent (see Appendix F.4). Figure 6.6 shows the location of pumping wells that have been taken into account in the model. Table 6.5 indicates the water abstraction rate from each well. According to the modelling simulations, ceasing pumping from both abstraction wells in the Heathcote Valley would lead to increased hydraulic heads of up to 1.5m in the area of low potentiometric pressures (Appendix F.4). However, a sensitivity analysis has shown that the impact of ceasing pumping in the Heathcote Valley is very dependent on Aquifer 1 hydraulic conductivity. Also the model represents steady-state conditions and does not explore temporal aquifer response. Therefore the results should only be regarded as an indication.

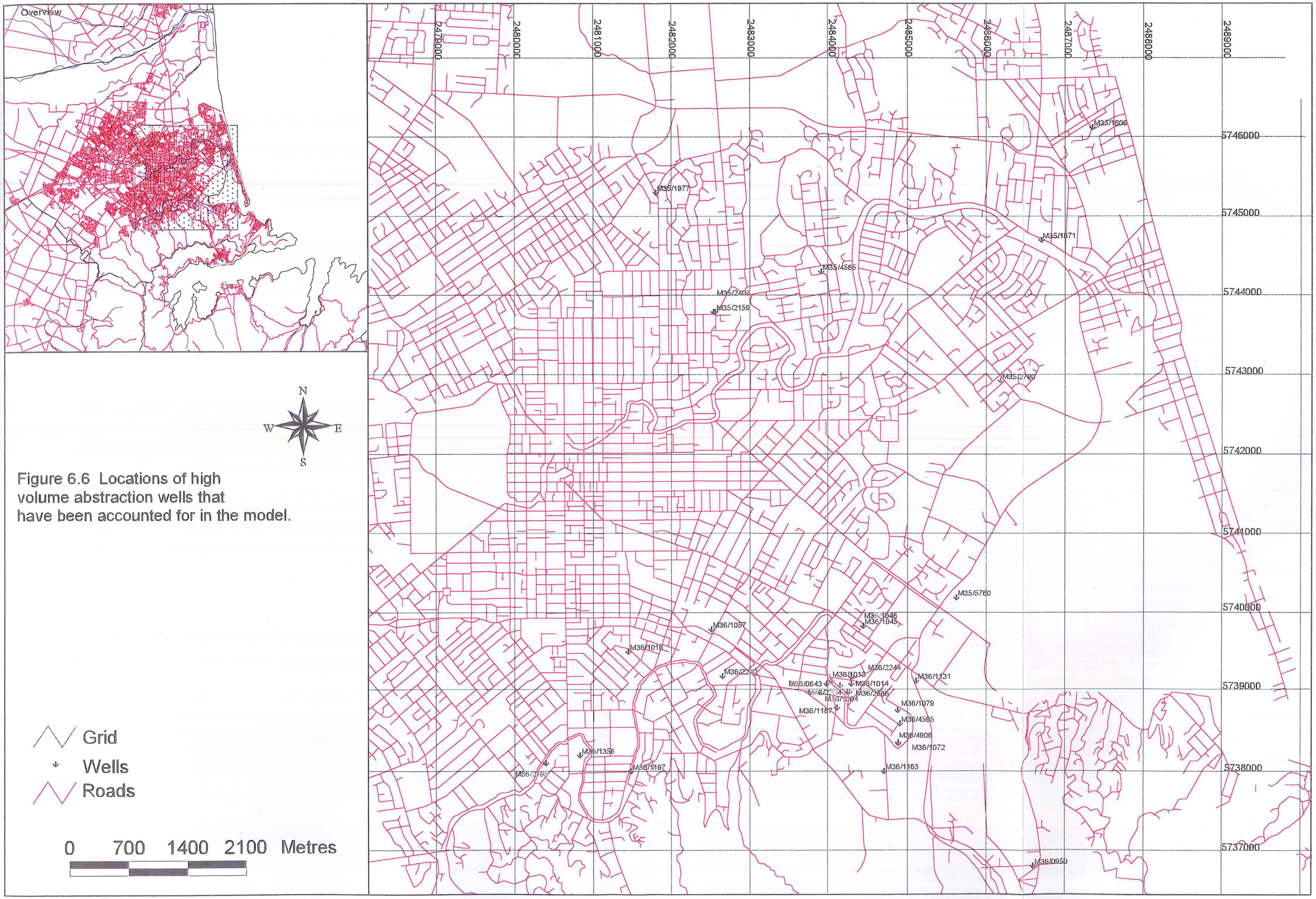

Figure 6.6 Locations of high volume abstraction wells that have been accounted for in the model.

Well no	Grid Reference	Depth	Owner	Abstraction rate [m3/day]	Comment
M35/5760	M35:8562-4019	68.00	BPDC P.O.BOX 4 LYTTELTON	not pumped	
M36/0643	M36:843-392	32.30	RESOURCE OIL LTD.	no significant water pumped	
M36/0950	M36:866-368	21.30	MUNNINGS .G.	no significant water pumped	
M36/1004	M36:8423-3900	32.30	LEINER DAVIS GELATINE(NZ)	301	average of 1994-95 data
M36/1013	M36:8414-3908	36.20	LEINER DAVIS GELATINE(NZ)	550	average of 1994-95 data
M36/1014	M36:8428-3910	30.40	LEINER DAVIS GELATINE(NZ)	362	average of 1994-95 data
M36/1045	M36:8443-3983	34.10	CHCH CITY COUNCIL	212	average of 1994-95 data
M36/1046	M36:8450-3978	79.80	CHCH CITY COUNCIL	105	average of 1994-95 data
M36/1057	M36:82509-39790	33.50	CHCH CITY COUNCIL	4282	average of 1994-95 data
M36/1072	M36:850-383	32.40	INDEPENDENT FISHERIES	1574	max abstr.based on consent
M36/1079	M36:849-388	74.10	BOWRON & CO LTD	1158	
M36/1163	M36:847-380	33.80	HEATHCOTE C.C.	1289	average of 1994-95 data
M36/1187	M36:841-388	37.10	HEATHCOTE.C.COUNCIL	1253	average of 1994-95 data
M36/2204	M36:840-391	32.90	SKELLERUP INDUSTRIES	2758	average of 1994-95 data
M36/2244	M36:840-392	36.00	DUNLOP INDUSTRIAL	864	average of 1994-95 data
M36/2586	M36:8426-3900	74.37	LEINER DAVIS GELATINE(NZ)	653	average of 1994-95 data
M36/4595	M36:849-386	74.70	BOWRON, G.L.& CO.	808	average of 1994-95 data
M35/1606	M35:8735-4612	98	CHCH CITY COUNCIL	1100	average between 1/1/1994 and 1/6/95
M35/1871	M35:867-447	103	CHCH CITY COUNCIL	481	average between 1/1/1994 and 1/6/95
M35/1977	M35:818-453	94	CHCH CITY COUNCIL	4311	average between 1/1/1994 and 1/6/95
M35/2159	M35:82557-43791	40	CHCH CITY COUNCIL	4026	average between 1/1/1994 and 1/6/95
M35/2403	M35:82535-43791	86	CHCH CITY COUNCIL	4026	average between 1/1/1994 and 1/6/95
M35/2790	M35:86184-42922	95	CHCH CITY COUNCIL	1074	average between 1/1/1994 and 1/6/95
M35/4565	M35:839-443	60	CHCH CITY COUNCIL	13	average between 1/1/1994 and 1/6/95
M36/1197	M36:81484-37998	31	CHCH CITY COUNCIL	245	average between 1/11/94 and1/6/95
M36/1356	M36:8083-3820	28	CHCH CITY COUNCIL	7757	average between 1/11/94 and1/6/95
M36/2195	M36:804-381	20	CHCH CITY COUNCIL	425	average between 1/11/94 and1/6/95

Table 6.5 Abstraction rates of pumping wells that have been accounted for in the model.

6.4.10 Sensitivity analysis

A sensitivity analysis has been undertaken to examine the reliability of the management scenarios. Aquifer 1 and Aquitard 1 hydraulic conductivities have been altered by factors of 0.5 and 2 in the Heathcote Valley. The hydraulic heads showed a more sensitive response to altering Aquifer 1 hydraulic conductivity than to altering Aquitard 1 hydraulic conductivity. After Aquifer 1 or Aquitard 1 hydraulic conductivities had been altered, the hydraulic heads of wells in the Heathcote Valley were recalibrated to the observed hydraulic heads by altering Aquitard 1 or Aquifer 1 hydraulic conductivities, respectively. Water abstractions were then ceased from the wells M36/1163 and M36/1072 and the response of the hydraulic heads of wells in the Heathcote area was observed. Again the aquifer system response was more sensitive to a change in Aquifer 1 hydraulic conductivity (see Appendix F.5).

While the model in the Heathcote area was most sensitive to Aquifer 1 hydraulic conductivity, overall the model was more sensitive to Aquitard 1 hydraulic conductivity than to Aquifer 1 hydraulic conductivity (see Appendix F.6).

This presents a problem due to the scarcity of data for aquitard leakance in the confined area of the Christchurch artesian aquifer, which was discussed in Chapter 3.

6.4.11 Conclusions

The modelling study has shown that the hydraulic conductivity of Aquifer 1 is likely to be less in the Heathcote Valley than elsewhere in Christchurch. This leads to an increased drawdown effect of water abstractions from wells in the area. Consequently water abstractions from the two major Aquifer 1 pumping wells (well no: M36/1163 and M36/1072) have drawn hydraulic heads below sea level.

Water abstractions from other Aquifer 1 wells outside the Heathcote area exhibit only a minor effect in Aquifer 1 in the area of low potentiometric heads. Pumping restrictions of the two pumping wells in Heathcote are therefore necessary to obtain increased water levels in the area of low potentiometric heads.

6.5 Combating groundwater contamination in the Heathcote Valley

Saline intrusion in the Heathcote Valley is caused by a downward hydraulic gradient between the estuary and Aquifer 1. Pumping from the wells M36/1163 owned by Christchurch City Council and M36/1072 owned by Independent Fisheries has reversed the natural upward hydraulic gradient and drawn heads below sea level.

The computer modelling study, specific to the study area, indicates that pumping restrictions, or more likely a relocation of the abstraction sites in the Heathcote Valley, are necessary to obtain sustainable Aquifer 1 hydraulic heads in the area. Pumping wells in Woolston, close to the area of low hydraulic heads, seem to exhibit only a small effect on the water levels in the Heathcote Valley.

As modelling results indicate, the abstractions from the two wells in the Heathcote Valley had the most significant effect on the area of low hydraulic heads. Therefore, as interim measure, it is recommended that only half of the presently abstracted amount of water from the two wells should be consented initially. The monitoring network constructed during this investigation should be used to study the effects of the pumping restrictions on water level recovery and groundwater quality trends. If the pumping restrictions do not lead to a sufficient recovery of the aquifer system, they should be gradually increased until the desired sustainable water levels are obtained in the Heathcote Valley. The objective of managing these abstractions is to obtain an upward hydraulic gradient between Aquifer 1 and in the estuary. However, the density difference between freshwater and seawater also needs to be taken into account to prevent downward leakage of estuarine water. The Ghyben-Herzberg relationship (see Section 5.2) should therefore also be applied to calculate sustainable water levels.

A high quantity of freshwater may be needed to flush the saltwater already contained within the pores of the aquifer and it may take a long time for the system to recover (CUSTUDIO, 1987). It is therefore feasible that abstraction reductions may not lead to sufficient water quality recovery immediately.

If it is necessary to relocate the abstraction sites, the location of the new groundwater abstraction sites should be carefully chosen to avoid a repetition of the problem.

In the Woolston/Heathcote area, population growth is expected (ERIC VAN TOOR, 1998, *pers.comm.*). To cover future demands it may be necessary to assess the possibility of artificial recharge via injection wells. Computer modelling studies and preliminary field tests are recommended to study the feasibility of artificial recharge. This option may not be desirable as it is generally very expensive.

As indicated previously groundwater contamination in the study area was observed from water, abstracted from a single Aquifer 2 well (well no: M36/4595) and a single Aquifer 3 well (well no: M36/1149). It is suspected to be caused by vertical leakage, due to leaky piezometers and/or well casings. Consequently leaky wells should be identified and repaired. Since many of them will appear to have been concealed by buildings and roads, this may be difficult task. Therefore adequate controls on sealing must be applied when it comes to abandoning wells to ensure that the problem does not affect the groundwater quality in the future.

6.6 Preventing seawater intrusion

In Christchurch it is believed that the freshwater/seawater interface has not yet intruded landward of the coast (see Chapter 5). However, localised seawater intrusion by downward leakage of saline water from the estuary is observed in the Heathcote Valley. More significant effects would be expected if the freshwater/seawater interface moved onshore. Along the coastal strip of Christchurch, including the area around the estuary, the potential risk of seawater intrusion is greatest for the Riccarton Aquifer, as the aquifer pressures are lowest in this uppermost aquifer and seawater may intrude by downward leakage through the top confining layer. The following recommendations are made to prevent seawater intrusion:

- No new abstraction wells within Aquifer 1 should be drilled in the Heathcote Valley and on the southern part of South New Brighton Spit. In addition a precautionary approach is recommended prior to allowing new Aquifer 2 and 3 wells in this area.

- The area closer to the estuary and along the shoreline should be defined as an aquifer protection zone, where water allocations should only be granted if adverse environmental effects are minor.
- A water quality and water level monitoring network which takes into account the vertical hydraulic gradient, especially between the top confining layer, Aquifer 1, and seawater is necessary to identify problems early. It is therefore recommended to expand the existing network of water level monitoring wells by installing shallow 3-6m deep piezometers close to existing Aquifer 1 water level monitoring wells especially along the shoreline and around the estuary.
- To ensure that the freshwater/seawater interface does not migrate onshore, the Ghyben-Herzberg relationship should be applied to calculate sustainable water levels. For example if the aquifer is 50m deep, according to the Ghyben-Herzberg relationship a freshwater hydraulic head of 1.25m should keep the interface offshore. In order to be on the conservative side, however, it is recommended that the value be doubled and to use it as a guideline for minimum water levels.
- A concentrated network of Aquifer 1 pumping wells should be avoided along the shoreline and around the estuary to avoid accumulated drawdown effects. Water abstraction wells should preferably be drilled into deeper aquifers.
- New wells must be sufficiently grouted to prevent vertical leakage (CUSTUDIO, 1987) and a monitoring programme to ensure that is the case, may be needed.
- Abandoned wells need to be sealed sufficiently to avoid vertical leakage even if the well casing becomes corroded or broken (CUSTUDIO, 1987). Again checks may be needed to ensure this happens.
- Further refined groundwater modelling work may help to predict seawater intrusion and to identify ways to avoid it.

7 Summary and conclusions

7.1 Summary and conclusions

The primary objective of this study was to determine the source(s) of observed groundwater contamination within the Woolston/Heathcote area, Christchurch, New Zealand.

Christchurch City is underlain by a multilayered, confined, artesian aquifer system which supplies the city with untreated, high quality drinking-water. The main groundwater-bearing aquifer is the Riccarton Aquifer, also called Aquifer 1. It is the uppermost aquifer at 5-40m depth below ground surface. It is up to 30m thick and believed to outcrop approximately 40km offshore (TALBOT *et al.,* 1986). Beneath the Riccarton Aquifer are the Linwood, Burwood, and Wainoni Aquifers, each of them separated by confining layers. The aquifer system was formed during the Quaternary period and consists of high permeability coarse alluvial gravel strata (aquifers) and low permeability fine alluvial and marine layers of silt, clay, peat, shelly sand and clay (aquitards). Natural recharge to the system occurs via river recharge, rainfall recharge, throughflow from the west, and upward leakage from underlying aquifers. Natural discharge occurs via springs, drains, upward leakage through the uppermost confining layer, and horizontal outflow through the offshore outcrop.

Groundwater contamination occurs in the south-eastern part of Christchurch City in the Heathcote Valley and in the southern part of South New Brighton Spit, as evidenced by an increased salinity of the groundwater. The area is located along the northern margin of Banks Peninsula, an extinct volcanic complex comprised of fractured lithologies of low hydraulic conductivity, and near the Estuary of the Avon and Heathcote Rivers (Figure 1.1).

A potentiometric survey, carried in Woolston/Heathcote indicated an area of potentiometric heads below sea level for Aquifer 1 in the Heathcote Valley. Results of a hydrochemical sampling programme clearly showed that wells yielding degraded groundwater quality are located in the area of low potentiometric heads. A review of previous hydrochemical data led to the conclusion that seawater and some landfill leachate are the most likely contaminant sources. Groundwater flow patterns obtained from the potentiometric survey suggest that the contaminants might be drawn into the aquifer by high volume abstraction wells from the estuary. Other possible contaminant sources such as thermal groundwater, or connate water within the marine layers on top or below Aquifer 1, are less likely given the water chemistry trends.

In the Heathcote Valley large volumes of groundwater are abstracted to meet industrial and public water supply needs. However, the aquifers in the Heathcote area are in a recharge "shadow" behind a ridge of Banks Peninsula rocks, which occurs to the west of the Heathcote Valley. A buried volcanic sea stack identified by WEEBER (1993) is also believed to act as a barrier to the throughflow of groundwater from the Canterbury Plains. Further, the reduced thickness of Aquifer 1, the partial absence of lower aquifers, and the low aquifer hydraulic conductivity in this area lead to limited groundwater availability compared to elsewhere in Christchurch. Therefore, the impact of groundwater abstractions is more significant in the Heathcote area compared with elsewhere. Contaminants, moving into groundwater, will also be resident longer than elsewhere as they will not be flushed from the system, nor diluted with ongoing recharge through the aquifer.

A groundwater model specific to the study area has been constructed to facilitate groundwater management in the area. The modelling work showed that Aquifer 1 hydraulic conductivity is likely to be lower in the Heathcote Valley than elsewhere in Christchurch resulting in increased drawdown effects from abstractions. Pumping from the wells M36/1163 and M36/1917 (owned by Christchurch City Council) and M36/1072 (owned by Independent Fisheries) is likely to cause the observed low potentiometric heads in the Heathcote Valley. Pumping restrictions on these wells would be the easiest option to increase water pressures above mean sealevel. According to the model simulations, pumping restrictions on other wells in the Woolston area, close to the area of low potentiometric heads, had only a minor impact on Aquifer 1 hydraulic heads in the Heathcote Valley. This is also indicated by the Aquifer 1 potentiometric contour map (Figure 4.6), which shows that the area of potentiometric heads below sea level is localised around the pumping wells in the Heathcote Valley.

To aid in determining the "sustainable yield" of the Heathcote aquifer system a groundwater level and quality monitoring network was designed and constructed. It can now be used to determine, whether pumping restrictions on wells in the Heathcote Valley are sufficient to remediate groundwater contamination from downward leakage. If the implemented pumping restrictions prove insufficient, further usage restrictions will be necessary.

In the past, seawater intrusion into the Christchurch artesian aquifer system has been regarded as low risk because the freshwater/seawater interface was considered to be 40km offshore where the Riccarton Aquifer is believed to outcrop (TALBOT *et al.*, 1986). However, modelling work conducted during this study showed that the freshwater/seawater interface location is dominated by leakage through the uppermost confining layer and not, as assumed previously, by lateral inflow of seawater through the offshore outcrop. The steady-state modelling results suggest that the interface in Aquifer 1 within a cross-sectional area in Christchurch is located at approximately 3.3km offshore. However, the lateral hydraulic gradients at the coast are very flat which makes it difficult to accurately determine the position of the freshwater/seawater interface. Also, the interface distance offshore will vary spatially and temporarily with water level variations along the coastline.

Groundwater contamination in the Heathcote Valley is a first indication that seawater intrusion is a potential risk for the quality of groundwater within the Christchurch artesian aquifer system. Future groundwater management will be required to address the risk of seawater intrusion by focusing on maintaining sustainable water levels in the onshore and nearshore area.

7.2 Suggestions for Future Work

- The water level and water abstraction history of the Heathcote Valley should be reconstructed. The temporal trend of initial water levels recorded for wells, drilled in the area, should be investigated. For example M36/1163 was drilled in 1961 and had and initial hydraulic head of 0.48m, M36/1917 was drilled in 1974 and had an initial hydraulic head of –0.613m, etc. This data should be matched with the known abstraction rates and history of well usage that has occurred in this area. This might lead to understanding of when, and at what abstraction rates, the sustainable yield of the Heathcote Valley aquifer system was exceeded.

- Ongoing water usage data need to be collected from pumping wells in the Heathcote Valley.
- Long-term water level monitoring equipment still needs to be installed at well M36/1917 penetrating Aquifer 1 and the 6m deep well beside it (M36/5570).
- Management measures need to be considered for pumping wells in the Heathcote Valley. These should be determined by the CRC in consultation with well users. Management measures should involve a consideration of the effects of poor quality water and the various approaches to managing water use that will avoid adverse environmental effects. The monitoring network constructed during this study should be used to determine whether the management methods lead to sustainable resource usage in the area.
- The constructed groundwater flow model, specific to the study area, requires refinement. A transient calibration should be attempted using the water level data obtained from the groundwater-monitoring network in the study area. The refined model could be used to investigate the response of the aquifer system to the relocation of abstractions from wells within the Heathcote area, to explore the response of the aquifer system to abstractions from wells to be drilled in the future, and to simulate artificial recharge. The model should be used to define groundwater flow path using MODPATH. The contaminant transport model MT3D may also help to obtain a better understanding of groundwater contamination that occurs in the study area. However, modelling results should not be overrated. Modelling work is a tool to enhance the understanding of the system. The focus must stay on groundwater monitoring for decision making.
- The Christchurch artesian aquifer system is known to be leaky (TALBOT *et al.*, 1986). However, there are few data on the leakance of the confining layers. More pump tests are needed, especially in the confined area of the aquifer system, to determine leakance values. These are essential to predict the susceptibility of the aquifer system to groundwater contamination by leakage of a contaminant source through the confining layers. Also, the constructed cross-

sectional Sharp model and the Visual MODFLOW model specific to the study area were shown to be most sensitive to leakance. Better field data will therefore enable refined modelling scenarios.

- More slug tests should be conducted in the confined area of the aquifer system to determine the leakance of the uppermost confining layer.

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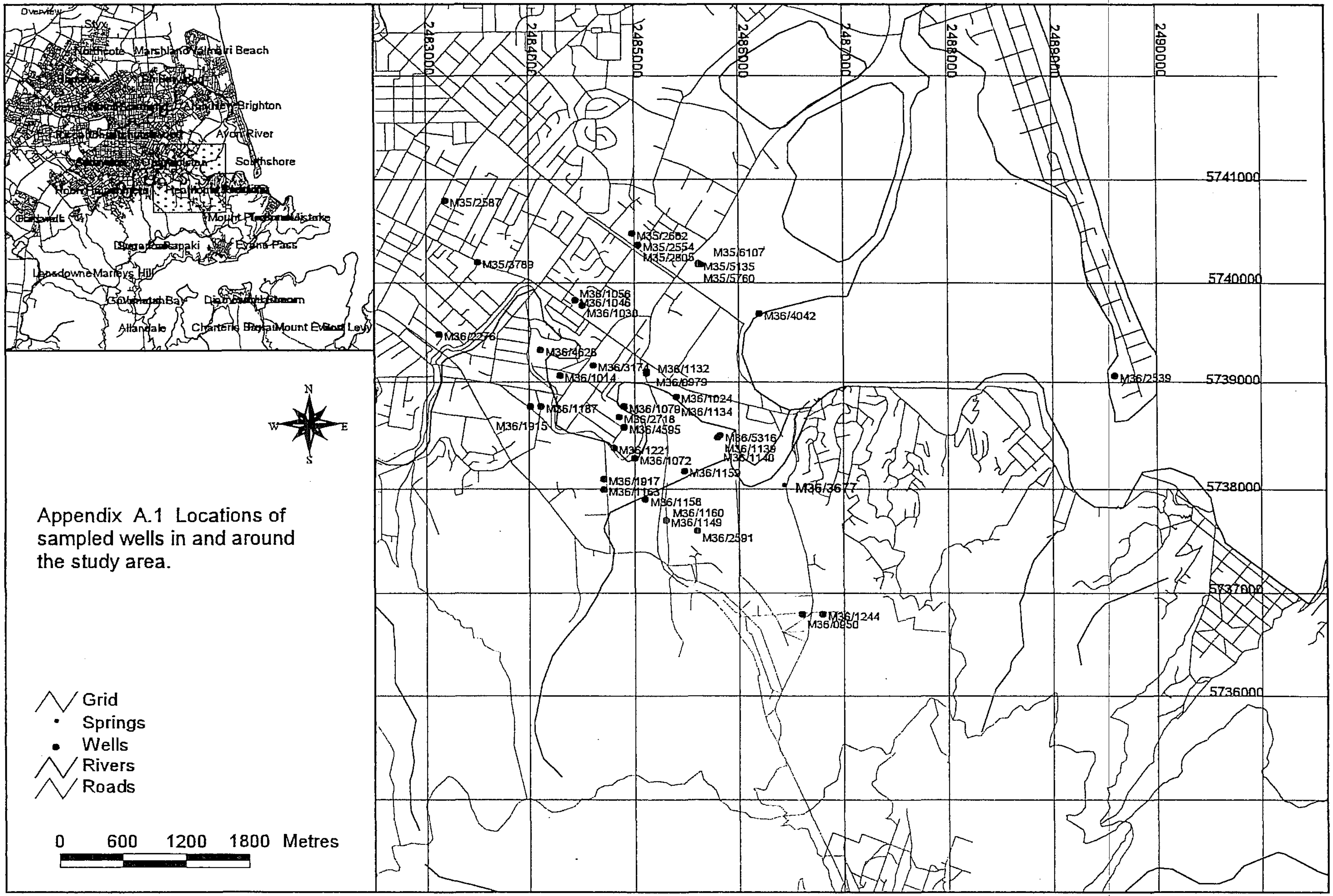


Appendix A.1 Locations of sampled wells in and around the study area.

Appendix A.2 Water quality of sampled wells in and around the study area.

WELL NO	DEPTH m	DATE	PH pH	COND mS/m	BR g/m3	NO3N g/m3	B g/m3	SIR g/m3	HCO3 g/m3	CO3 g/m3	FED g/m3	CL g/m3	SO4 g/m3	LID g/m3	NAD g/m3	KD g/m3	MGD g/m3	CAD g/m3	SRD g/m3	F g/m3	MND g/m3
M352554	134.4	29/04/63	7.4			0					0	4									
		20/06/73	7.8			0.15		18	67	0	0.04	5	5		9.7	0.8	2	15		0.1	0
		9/02/83	7.8	12.2	0	0.2		19	66		0	4.9	5.3		9.3	0.54	2.1	14			0
M352587	129.5	5/05/82	7.8	10.2		0.1		19	53		0	3.5	5.5		7.4	0.5	1.5	12			0
M352662	39.6	16/08/85	7.4	12.4	0	0		25	75	0	0.41	4.2	0.6		9.8	0.09	2.8	13			0.07
M352805	134.4	1/07/64	7.5			0.1		18	70			5					3	16			
		22/06/81	7.8	11.4		0.1		21.1	66		0	2.5	4		9.9	0.8	1.2	14.5			0
M355135	155.4	20/11/85	7.6	15	0	0.15	0	14	69	0	0	4.8	3.4		9.8	0.9	2	15.6	0.09	0.08	0
		19/02/86	7.8	13.2	0	0.14	0	18	79	0	0	4.7	3.3		9.3	0.9	1.6	15	0.09	0.14	0
		15/12/93				0.1															
		29/02/96	8	13		0.1		19	72			4	3.1							0.1	
M356107	39.1	15/03/89	7.3	13	0	0			62	0	0	3.9	1.7		9.7	0.93	2.6	15		0.13	0.12
		12/05/94	7.8	14	0.05	0.05	0.1	23	72		0.05	3.6	1	0.01	10	1.3	2.5	11.7	0.08	0.1	0.11
		22/06/97	7.6	17		0.25	0.02		72		0.24	3	0.5	0	9.9	1	2.4	12	0.08	0.13	0.14
M360950	21.3	14/07/82	7.5	11		1					0	9	6.8								0
M361024	76.2	6/12/66	7.3			0		10	73	0	0	4	4				4	12			0
		7/01/93	7.9	13	0.05	0.05		21	68	0	0.05	5.1	1		12	1.2	3.1	10.9		0.1	0.03
		21/02/94	7.8	15	0.05	0.05			66	0		8.9	1.7		15	1.2	3.4	12		0.1	
		7/02/95	7.9	15	0.05	0.05	0.03	21	76		0.05	10	2.5	0.01	14	1.1	3.7	12	0.07	0.1	0.01
		23/01/96	7.8	16.5	0.05	0.05	0.03	22	75			14	2.4							0.1	
		5/12/96	7.7	15	0.05	0.05	0.03	20	75			9.8	1.8							0.1	
M361030	130.1	14/06/82	7.9	10.8		0			61		0	4.5	4.5		9	0.5	2	13			0
M361045	34.1	1/07/64	7.5			0.1		18	68			5					3	16			
		22/06/81	7.4	15.1		1.4		19.8	67		0	6	11		9.2	0.9	2.5	20.8			
		20/06/89	7.9	13.4		0.2						6	8								
		15/07/92	7.5	13.3					68			5	5								
		3/12/92	7.9	13		0.2						4.7	3.4								
		29/11/93	7.7	13.2		0.1			68		0.05	4.5	3.1		10	1	2	13.9			0.01
		25/05/94	7.9	13	0.05	0.1	0.1	21	63		0.05	4.6	3.4	0.01	12	1.1	2.1	12.3	0.07	0.1	0.01
		17/11/94	7.9	13		1.4						6	2.5		9.1	0.9	2.8	14			
		23/11/95	7.9	13		0.3			71			5	3.8								
		20/11/96	7.9	13.5					71			5	4.4								
M361046	79.8	7/12/82	7.9	12.1	0	0.1			64		0	4.7	3.6		8.5	0.8	2	14			0
		25/05/94	7.9	12	0.05	0.1	0.1	20	60		0.05	4.2	3.5	0.01	11	1	2	11.8	0.06	0.1	0.01

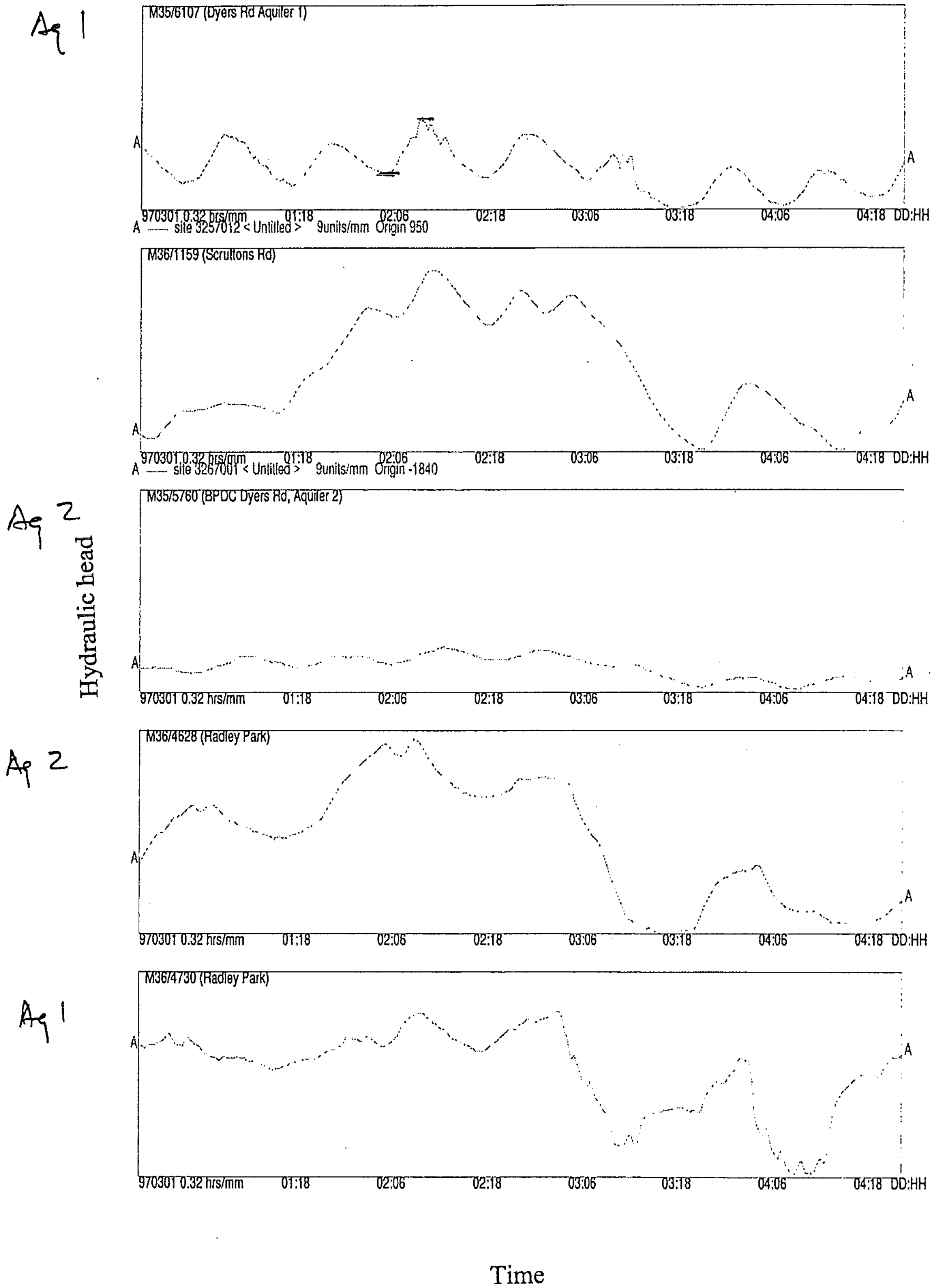
WELL NO	DEPTH m	DATE	PH pH	COND mS/m	BR g/m3	NO3N g/m3	B g/m3	SIR g/m3	HCO3 g/m3	CO3 g/m3	FED g/m3	CL g/m3	SO4 g/m3	LID g/m3	NAD g/m3	KD g/m3	MGD g/m3	CAD g/m3	SRD g/m3	F g/m3	MND g/m3
M361056	135	20/10/66	7.5			0		12	55	0	0	5					3	16			0
		11/07/73	7.7			0.2		22	67	0	0	6	4		9.3	0.8	2	15		0.01	0
		22/06/81	7.8	11.1		0.1		22	64		0	3.5	3.5		9.4	0.7	1.3	14			0
		14/08/85	7.5	12.5	0	0.2		29	69	0	0	4.6	3.3		9.4	0	1.8	14			0
M361072	32.4	22/06/89	7.9	129		0.14						330	56								
		12/05/94	8	139	1.4	0.05	0.1	26	140		0.05	360	56	0.01	164	4.2	27.3	84	0.57	0.1	0.01
		11/06/97	7.8	130					130		0.06	310	43		140	3.3	26	81			
M361158	35	14/04/75	7.4			0.2		40	124		0	130	24		47	5	29	31			0
		25/12/83	7.4	60		0.16		24	142		0	125	27		57	6	28	33			0.02
		2/04/86	7.4	62		0.3		23	154		0.33	125			75	5.5	28	31			0
		8/06/87	7.3	73.1		0.145		25.7	177		0.8	140	80		81	6.4	27	35			0
		11/05/94	7.6	87	0.5	0.2	0.1	28	171		1.7	160	52	0.02	79	7.1	34	38	0.27	0.1	0.02
M361159	33.8	25/12/78	7.5			0.1		24	83		0.28	166	28		41	5.2	46	35			0
		25/12/83	7.2	204		0		22	62		0	730	80		167	9.6	134	97			0.06
		2/04/86	7.1	258		0.1			72		0.68	1100			260	9.9	150	110			0.28
		8/06/87	7	243.6		0.052		23.1	68		0.22	780	210		213	11	124	90			0.1
		11/05/94	7.2	515	6.1	0.05	0.1	23	64		0.4	1700	180	0.06	410	18	310	196	1.92	0.1	0.37
		8/02/95	7.1	511	3.5	0.05	0.03	22	64		0.3	1700	230	0.08	360	10	230	210	2.1	0.6	0.34
		23/01/96	7.1	510	6	0.2	0.03	22	66			1700	190							0.1	
		5/12/96	7	490	5.1	0.05	0.03	20	65			1700	180							0.1	
		11/06/97	7	520					65		0.13	1600	190		400	17	330	210			
M361160	29.2	16/12/74	7.5			0.39		24	154		0.05	250	13		102	12	53	28			0
		14/04/75	7.3			0.3		40	156		0.06	240	40		96	11.6	44	36			0
		25/12/78	7.3			0.1		32	140		0.2	134	27		78	11.6	31	21			0.05
		25/12/83	7.3	76.5		0.05		26	142		0	180	27		92	11.9	33.7	22			0.81
		2/04/86	7.4	83.4		0.1		27	143		0.2	190			110	10	38	27			0.89
		8/06/87	7.3	78.8		0.075		28.2	155		0	160	60		104	11	30	19			0.9
		11/05/94	7.4	169	1.2	3.4	0.1	32	204		0.2	380	92	0.02	160	17	79	56	0.64	0.1	1.64
M361163	33.8	24/10/61	7.9			0					0	13									
		29/05/67	7.5			0					0	17									
		25/05/94	7.8	69	0.4	0.3	0.1	23	119		0.05	132	35	0.02	61	5.4	29.1	27.3	0.19	0.1	0.01
M361187	37.1	13/07/65	7.4			0			63		0.12	5									
		7/09/82	7.8	12.3		0.2		18	61		0	5.5	5.5		8.4	0.9	2.6	14			0
		25/05/94	7.8	14	0.05	0.1	0.1	19	61		0.05	8.5	5.1	0.01	11	1.2	2.9	12.2	0.05	0.1	0.01

WELL NO	DEPTH m	DATE	PH pH	COND mS/m	BR g/m3	NO3N g/m3	B g/m3	SIR g/m3	HCO3 g/m3	CO3 g/m3	FED g/m3	CL g/m3	SO4 g/m3	LID g/m3	NAD g/m3	KD g/m3	MGD g/m3	CAD g/m3	SRD g/m3	F g/m3	MND g/m3
M361244	45.8	2/04/73									0.64	696					60	89			
		11/05/94	6.8	215	1.1	19	0.3	25	214		0.05	470	130	0.02	335	1.7	39	48	0.57	0.1	0.04
M362591	29	3/07/74	7.1			0.9		36	170		0.14	264	43		106	8.4	60	47		0.1	0.09
		16/12/74	7.3			1		32	178		0.1	370	17		106	8	74	52			0.09
		25/12/78	7.1			0.9		36	170		0.14	264	43		106	8.4	60	47			0.09
		25/12/83	7.3	110		0.58		29	159		0	296	45		125	9.3	48	40			0.54
		2/04/86	7.1	190		1.7		33	191		0.1	650			190	11	64	54			0.7
		9/06/87	7	261.2		0.64		30.8	144		0.05	760	340		289	22	126	87			1.4
		7/01/93	7.4	166	1.8	3.3		36	200		<0.1	400	74		150	12	71	69		0.1	0.65
		21/02/94	7.2	170	1.3	3.4			190			390	82		150	11	72	70		0.1	
		7/02/95	7.2	160	1.2	3.2	0.1	36	220		0.1	370	90	0.03	710	34	56	80	0.57	0.1	0.53
		23/01/96	7.2	160	0.4	3.1	0.1	38	220			390	71							0.1	
		5/12/96	7.2	160	1.1	3.2	0.08	35	217			380	65							0.1	
		11/06/97	7.2	160					220		0.28	360	65		140	9.1	67	79			
M363174	3.3	27/01/87	6.9	19.1		5.8		14.8	15	0		17	5								
M360979	36.5	29/01/75	7.8			0.08			72			5	5		10	1	3	15			
		29/01/75	7.8			0.06			72			7	4		11	1.1	5	12			
		7/01/93	8	13	0.05	0.1		20	65	0	0.05	5	3.8		9.9	1	2.2	15		0.1	0.01
		21/02/94	7.9	18	0.05	0.1			70	0		8.7	11		12	1.3	5	16		0.1	
		7/02/95	7.9	18	0.05	0.05	0.03	20	79		0.05	10	13	0.1	12	1.2	5.3	16	0.1	0.1	0.01
		23/01/96	7.7	17.5	0.05	0.2	0.03	20	80			8.2	11							0.1	
		5/12/96	7.8	19	0.05	0.2	0.03	19	81			8.5	11							0.1	
		11/06/97	7.7	19					81		0.06	9	11		12	1.4	5.7	17			
M362276	59.8	9/01/91	7.7	12						0		4	2.5								
		11/05/94	7.9	12		0.2	0.1	17	58	0	0.5	4.5	3.6	0.01	6.6	0.8	1.9	14.2	0.09	0.1	0.01
M364595	74.7	11/05/94	8.2	31	0.05	0.3	0.1	26	79		0.05	40	8.7	0.01	31	1.6	4.4	20.9	0.14	0.1	0.01
		11/06/97	8.2	22					83		0.06	21	5		23	1.4	3.9	17			
M361221	36.5	11/05/94	8.5	14	0.05	0.2	0.1	26	69		0.05	4.5	3.5	0.01	16	1.1	2.7	9.5	0.06	0.1	0
M361079	74.1	11/05/94	8.2	17	0.05	0.2	0.1	23	69		0.05	12	4.6	0.01	13	1	2.6	15.3	0.1	0.1	0
M364628	75	12/05/94	8.1	13	0.05	0.2	0.1	18	70		2.8	4.4	4	0.02	9.8	1.4	2	13	0.1	0.1	0.15
M364628	75	12/05/94	8.4	16	0.05	0.9	0.1	18	67		0.05	7.1	7.3	0.01	8.8	1	2.4	19.1	0.12	0.1	0
M363677	spring	12/05/94	8	101		0.1	0.1	37	133		0.05	230	23	0.01	153	4.4	13.5	30	0.26	0.1	0.01
		29/03/95	7.9	101		0.26		34.3	134		0.1	233	22.3		153	5.6	13.7	32.1			
M361134	97.5	15/05/94	7.9	14		0.05	0.1	21	69		0.3	4.6	4.8	0.01	11	1.1	2.4	15.6	0.1	0.1	0.01

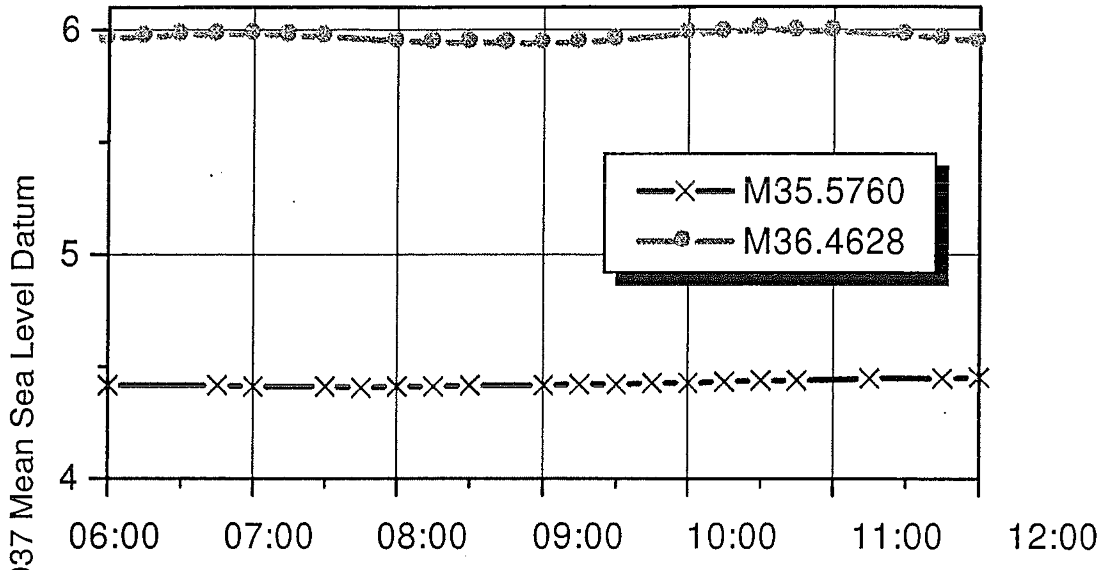
WELL NO	DEPTH m	DATE	PH pH	COND mS/m	BR g/m3	NO3N g/m3	B g/m3	SIR g/m3	HCO3 g/m3	CO3 g/m3	FED g/m3	CL g/m3	SO4 g/m3	LID g/m3	NAD g/m3	KD g/m3	MGD g/m3	CAD g/m3	SRD g/m3	F g/m3	MND g/m3
M361132	100.8	25/05/94	7.9	13		0.1	0.1	21	67		0.05	4.6	3.7	0.01	13	1.1	2.2	12.8	0.07	0.1	0.01
M361917	33.4	25/05/94	7.5	66		0.3	0.1	23	115		0.05	130	32	0.02	53	4.2	28.5	27.5	0.19	0.1	0.01
		31/06/97	7.7	120		0.62	0.07		210		0.06	240	72	0.02	110	6.6	50	42	0.36	0.09	0.02
M361139	73.1	26/05/94	8.7	16		0.05	0.1	20	74		0.1	4.7	4.3	0.01	13	0.9	1.7	14.3	0.08	0.1	0.01
		3/07/97		15		0.005	0.02		80		0.13	5	3	0	13	0.82	2	18	0.11	0.08	0.05
M362718	33.5	19/06/97	9.6	12		0.005	0.01		21		0.06	36	1	0	16	1.4	0.56	11	0.13	0.24	0.09
M355760	68	22/06/97	7.9	14		0.11	0.02		71		0.06	4	3	0.01	9.8	0.99	2.2	15	1	0.08	0.02
M353789	76.2	11/06/97	8	12					62		0.06	4	5		8.4	0.87	2.1	14			
M364042	34.1	17/06/97	7.6	40		0.005	0.02		111		0.41	11	0.5	0	13	1.3	5	22	0.13	0.15	0.21
M362539	49.16	17/06/97	7.2	60		0.005	0.03		150		1.7	110	0.5	0.03	63	5	9.2	28	0.22	0.19	0.39
M361140	71.3	3/07/97	7.9	15		0.005	0.02		78		0.14	4	3	0.01	11	1.3	3.3	16	0.07	0.09	0.02
M365316	?	3/07/97	7.9	15		0.005	0.02		75		0.14	5	4	0.01	11	1.4	3.4	16	0.07	0.07	0.02
M361014	30.4	24/06/97	7.4	16	0.022	0.4	0.02		70		0.13	7	9	0	9.5	1.2	3	20	0.1	0.06	0.02
M361915	36.4	25/06/97	7.7	14	0.019	0.21	0.02		63		0.06	6	4	0.01	9.4	1.2	2.8	14	0.07	0.06	0.02
M361149	96.9	17/06/97	7.7	68	0.397	0.2	0.05		137		0.58	130	23	0.02	79	5.8	15	29	0.16	0.14	0.02

Code	Parameter
ph	ph
COND	Conductivity
BR	Bromide
NO3N	Nitrate Nitrogen
B	Boron
SIR	Reactive Silica
HCO3	Bicarbonate Alkalinity
CO3	Carbonate Alkalinity
FED	Iron Dissolved
CL	Chloride
SO4	Sulphate
LID	Lithium Dissolved
NAD	Sodium Dissoved
KD	Potassium Dissolved
MGD	Magnesium Dissolved
CAD	Calcium Dissolved
SRD	Strontium Dissolved
F	Fluoride
MND	Manganese Dissolved

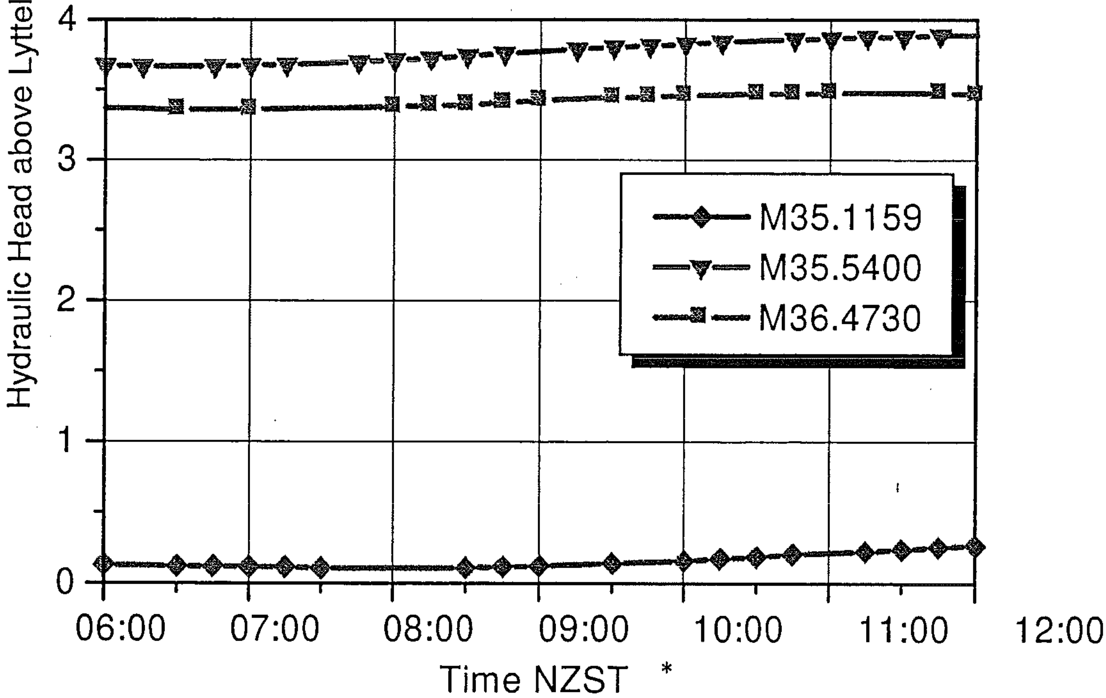
Appendix B.1 Hydraulic head versus time graphs of long-term water level monitoring wells in the study area (prepared by Dave Scott).



Appendix B.2 Hydraulic head versus time graphs which were used to recalculate the hydraulic heads observed during the potentiometric survey to a reference time of 11hours NZST (prepared by Marc Ettema).



Aquifer 2



Aquifer 1

* New Zealand Standard Time

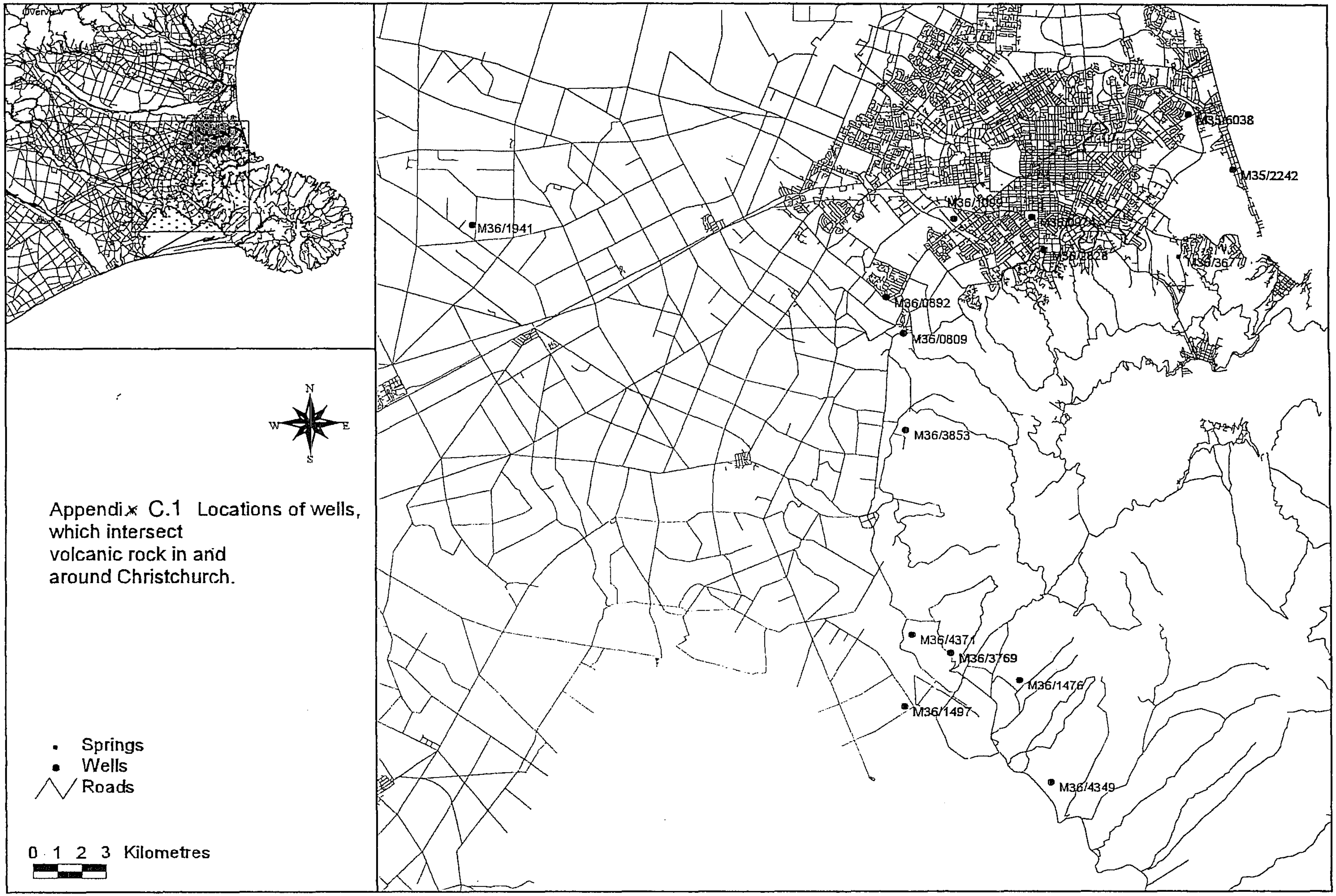
Appendix B.3 Data from the potentiometric survey in March 1997 (compiled by Author and George McEwan).

Well Number	Location/Owner	Aquifer	Time	Pressure (Kpa)	Height (m)	Datum (m)	Head above datum (m)	Tidal correction (m)	Head after Tidal correction	Measuring Point	Reference to measuring point (m)	Comment
M36/1159	CRC recorder Scruttons Rd	RI	915		-1.38	1.472	0.097	0.062	0.159	TOC	0.32 above GL	33.8mm/tide scale 3267001/MPAH not recorded
M36/1160	LBC By brick shed Scruttons Rd	RI	920		-1.27	1.627	0.362	0.058	0.420	TOC	0.3 above GL	35m/
M36/1158	LBC Behind dirt pile	RI	930		-2.47	2.047	-0.418	0.054	-0.364	TOC	GL	29.2m/
M36/1145	LBC 18 Beside railway Tracks	BU	1255	42.9	4.37	2.437	6.810	0.088	6.898	TOW	0.7 above GL	was identified as an Aquifer 3 well after the survey had been completed
M35/5244	47a Tilford St L Johnston	RI	950		1.45	2.699	4.149	0.040	4.189	Concrete Paving Stones	GL	27.2m/ behind the house
M36/2307	81 Wildberry St	RI	1005		1.01	3.400	4.405	0.032	4.437	TOC	0.5 above Gl	30.15m/ side of house
M36/2580	97 Mackenzie Ave	RI	1015		0.94	3.505	4.445	0.026	4.471	TOC	0.84 above GL	?beside concrete pad behind house
M36/2867	68 Richardson Tce	RI	1030		1.31	2.860	4.170	0.018	4.188	TOC	0.55 above GL	25.64m/ in garden between barbecue area and apple tree
M36/2241	131 Opawa Rd	LI	1228	42.8	4.36	4.510	8.873	0.070	8.943	TOW	0.8 above GL	87m/ by dog kennel and fountain
M36/2308	249 Fifield Tce	RI	1055		0.96	3.606	4.561	0.002	4.563	TOC	0.285 above GL	20.2m/ under tree front of section
M36/2276	47 Tabart St	LI	1240	40.9	4.17	3.370	7.539	0.077	7.616	CRC datum	TOC at GL	59.8m
M35/3764	Ernest Adams	RI	902		2.98	4.879	7.859	0.070	7.929	floor (GL)	at GL	30m aquifer 2??
M35/4040	32 Frederick St	RI	914		1.26	3.666	4.926	0.062	4.988	at concrete surrounding	1.2 above GL	-
M35/4364	73 Smith St	RI	926		1.90	2.419	4.314	0.056	4.370	TOW	well is at 0.35 above GL	Ground RA -99.4?(wells database) contact owner to inform about waterlevel
M35/2397	86 Tilford St	RI	935		0.80	3.220	4.020	0.050	4.070	tap at TOW	well is at 0.7 above GL	31.5m
M35/6094	Alameda kennels	RI	946		0.75	2.635	3.385	0.044	3.429	tap at TOW	0.75 above GL	
M35/4064	83 Wyon St	LI	*1210*	35.5	3.62	3.546	7.165	0.056	7.221	top of pipe	0.4 above GL	
M35/3695	6 Butterfield Ave	LI	1201	32.5	3.31	3.670	6.983	0.044	7.027	tap at TOW	0.55 above GL	39.6m/
M35/3721	53 Carnavon St	RI	1021		1.08	3.415	4.490	0.022	4.512	tap at TOW	0.75 above GL	30.1m/
M35/3692	9 Ngarimu St	RI	1028		0.83	3.600	4.425	0.018	4.443	tap at TOW	0.35 above GL	10.9m/
M35/3789	Woolston Primary School (CRC)	LI	905	40.7	4.15	2.610	6.759	0.051	6.810	CRC datum		76.2m/
M36/4906	Ind Fisheries Ltd	RI	922		-2.51	1.602	-0.908	0.057	-0.851	Top of stand pipe	0 .625 below GL	Adjacent pump operating 32.0m/
M36/1079	GI Bowron	LI	950	32.7	3.33	2.177	5.510	0.019	5.529	GL		74.1m/
M36/2718	GI Bowron	RI	1100	9.8	1.00	1.632	2.631	0.000	2.631	GL(within sealed area)		33.5m/
M36/4595	GI Bowron	LI	1110	31.8	3.24	2.262	5.504	0.006	5.510	at outlet (upstream of filters)		74.7m/
M36/2716	Winstone Wallboards	RI	1025		-0.81	3.679	2.869	0.020	2.889	surface storage tank	1.03 above GL	36.5m/
M36/1014	Tech department well	RI	1035	49.5	5.05	4.037	9.083	0.014	9.097	Top of pipe	0.59 above GL	30.4m/ ?? this well was not included because the high pressure suggests that in fact a backpressure was measured

Times in italics are estimated
GL-Ground Level
TOW-Top of Well
TOC-Top of Casing
RI-Riccarton Aquifer
LI-Linwood Aquifer

Well Number	Location/Owner	Aquifer	Time	Pressure (Kpa)	Height (m)	Datum (m)	Head above datum (m)	Tidal correction (m)	Head after Tidal correction	Measuring Point	Reference to measuring point (m)	Comment
M36/4578	Garvins Well	LI	1045	12.7	1.29	4.242	5.537	0.000	5.537	Top of pipe ?	0.82 above GL	74.6m/pumps off at 930
M36/2583	90 Opawa Rd	LI	1125	36.6	3.73	6.403	10.134	0.016	10.150	tap at TOW	0.6 above GL	-
M36/2589	25 Tabart St (Barry's well)	LI	1132	52.8	5.38	3.808	9.190	0.020	9.210	tap at TOW		Wellhead deep within foliage
M35/3816	Linwood High School	LI	1152	72.2	7.36	3.641	11.001	0.040	11.041	tap at TOW	0.67 above GL	35m?
M35/4546	Linwood Mall	LI	1159	42	4.28	3.276	7.557	0.043	7.600	CRC datum		Leaking slightly couldnt get a good seal
M35/2268	Pacific Canneries	LI	1212	11.7	1.19	5.275	6.468	-0.010	6.458	tap at TOW	0.15 above GL	
M35/7695	318 Pages Rd	LI	1224	41.1	4.19	6.064	10.254	-0.015	10.239	tap at TOW	0.76 above GL	Domestic supply for at least three houses
M35/2029	27 Ottawa St Nursery	LI	1236	22.2	2.26	4.690	6.953	-0.015	6.938	tap nearest well	0.47 above GL	
M35/5199	62 Wainoni Rd	LI	1245	21.2	2.16	5.560	7.721	-0.015	7.706	tap at TOW	0.58 above GL	
M35/2139	13 Wainoni Rd	LI	1250	43.7	4.45	3.331	7.786	-0.015	7.771	tap at TOW	0.53 above GL	
M36/1197	Palantine	RI	845		2.12	2.714	4.834	0.082	4.916	Top of pipe	0.58 above GL	look at Michaels photos for measuring point!
M36/1057	Ensors Rd	RI	910		1.37	5.850	7.220	0.064	7.284	Top of tap	0.9 above GL	possible measurement error
M36/1046	Woolston No 2	LI	*930*	32.1	3.27	2.984	6.283	0.038	6.337	Concrete Pad		
M36/1045	Woolston No 3	RI	*930*		0.49	3.011	3.474	0.054	3.512	top of wooden beam	at GL	
M36/1915	Tanner	RI	*1000*		-1.81	3.647	1.837	0.036	1.873	Bung on well head		
M36/1917	Chapmans	RI	*1030*		-3.05	2.387	-0.663	0.017	-0.646	at tobi cover	at GL	
M35/2790	Carters	LI	*0*	23.3	2.38	4.576	6.951	0.000	6.951	Frame of toby box	at GL	Well no 2: trouble with tap needs new one
M35/1871	Palmers	LI	1115	55.2	5.63	2.386	8.013	-0.005	8.008	Frame of toby box	at GL	refer field sheet MP different to surveyed level
M35/2242	Estuary	RI	1145		1.66	2.386	4.046	-0.013	4.033	refer field sheet		

Times in italics are estimated
GL-Ground Level
TOW-Top of Well
TOC-Top of Casing
RI-Riccarton Aquifer
LI-Linwood Aquifer



Appendix C.1 Locations of wells, which intersect volcanic rock in and around Christchurch.

Appendix C.2 Water quality of wells which intersect volcanic rock in and around Christchurch.

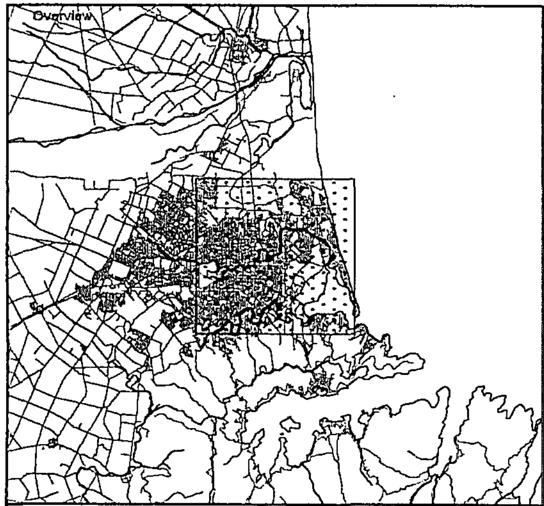
WELL NO	DEPTH m	DATE	TEMP C	PH pH	COND mS/m	CL g/m3	SO4 g/m3	HCO3 g/m3	CO2 g/m3	NAD g/m3	KD g/m3	MGD g/m3	FED g/m3	NO3N	MND
M360809	85.9	24/05/94		8.4	15.0	5.1	2.6	70.0	0.0	16.0		2.1	0.05	0.10	0.01
M364349	63	22/07/91		8.1	65.0	124.0	16.0	134.0	2.0						
		23/05/94		8.2	66.0	140.0	14.0	130.0	1.0	79.0		22.8	0.05	0.70	0.01
M363853	89.5	24/05/94		8.0	75.0	140.0	19.0	166.0	3.0	72.0		24.2	0.05	0.40	0.01
M363677	spring	12/05/94		8.0	101.0	230.0	23.0	133.0		153.0		13.5	0.05		
		29/03/95		7.9	101.0	232.9	22.3	134.0		153.1		13.7	0.10		
M364371	59	28/06/91	17.8	8.2	59.0	92.0	15.0	163.0	2.0	83.0		13.0	0.08		0.02
		23/05/94		8.2	57.0	93.0	13.0	165.0	1.0	83.0		12.9	0.05	0.20	0.01
M361099	29.8	19/12/67		6.6				98.0	39.0						
		27/04/89	12.5	6.3	58.2	33.0	100.0	106.0	87.0	35.0		9.6	0.11	12.00	0.00
		7/11/89	14	6.4	55.0	33.0	86.0								
		11/06/90	12.5	6.5	52.7	33.0	80.0								
		15/07/92		6.2	50.7	29.0	92.0	109.0	108.0	31.0		8.2	0.08		
		1/02/93		6.6	48.0										
		1/12/93		6.9	48.1										
		16/11/94		6.5	50.0	26.0	92.0	110.0		30.0		8.5		7.50	
		19/10/95		6.5	44.0	24.0	76.0	105.0							
		19/10/95		6.5	44.0	25.0	76.0	105.0							
		13/11/96		6.5	4.2	22.0	62.0	104.0							
		13/11/96		6.5	42.0	22.0	55.0	105.0							
M362828	29.4	12/07/88	10.2	9.2	14.3	11.0	19.0	32.0	0.0	12.0		1.6	0.21		0.05
		30/03/89	16	8.0	25.5	11.0	24.0	100.0	2.0	11.0		3.5	0.07	2.50	0.00
		27/04/89	13.5	8.2	23.5	9.0	21.0	93.0	1.0	11.0		3.1	0.10	2.10	0.00
		20/06/89	10.5	9.5	14.4	10.0	20.0								
		6/06/90	12.5	7.0	26.3	12.0	33.0								
		11/12/90		6.7	26.8	12.0	30.0								
		14/07/92		8.3	20.9	10.0	18.0	81.0	1.0						
		17/11/93		8.8	13.8	8.1	12.0	39.0	0.0	11.0		1.0	0.10	1.00	0.01

WELL NO	DEPTH m	DATE	TEMP 'C	PH pH	COND mS/m	CL g/m3	SO4 g/m3	HCO3 g/m3	CO2 g/m3	NAD g/m3	KD g/m3	MGD g/m3	FED g/m3	NO3	MN
M360974	40.5	29/07/58		6.8				25.0	13.0						
		23559		6.7		22.0		89.0				5.0			
		13/06/73		6.9		18.0	12.0	87.0	20.0	11.8		4.0	0.00	2.50	0.00
		17/07/73		6.8		16.0	12.0	85.0	25.0	12.0		5.0	0.00		
		3/03/82		6.9	26.6	24.0				13.4		5.0	0.00		
		27/04/83		6.6	29.8	22.0	23.0	88.0		13.8		4.4	0.00		
		7/12/87	14	6.7	33.4	23.0	24.0								
		18/04/88	13.5	6.9	32.5	23.0	23.0	102.0	21.0	16.0		6.9			
		14/11/88	13	6.6	34.6	23.0	27.0								
		30/03/89	13	6.8	33.1	24.0	30.0			16.0		6.9	0.00		
		27/04/89	13	6.7	35.4	24.0	27.0	106.0	35.0	16.0		7.0	0.00		
		6/06/90	12.5	6.9	37.4	26.0	31.0								
		28/11/90		6.8	38.4	26.0	30.0								
		3/12/91		6.7	38.6	25.0	35.0								
		14/07/92		6.7	38.3	25.0	32.0	114.0	38.0						
		1/12/92		6.8	39.0	26.0	33.0								
		29/11/93		6.9	40.1	25.0	37.0	114.0	24.0	19.0		7.3	0.05		
		17/11/94		6.8	38.0	23.0	41.0	115.0		18.0		7.8		6.90	0.01
		4/12/96		6.7	38.0	22.0	44.0	118.0							
M351941	54	20/04/54		7.2		6.0							0.00		
		4/05/88	13	6.9	16.1	7.0	12.0	64.0	10.0	8.4		2.8		2.30	
		13/07/88	12.5	6.9	16.3	8.0	12.0	63.0	8.0	8.2		2.7	0.04	2.40	0.03
		4/04/89	14	7.0	16.6	8.0	14.0	63.0	10.0	8.0		2.8	0.00	2.50	0.00
		21/06/89	12	6.9	17.5	9.0	13.0								
M361497		13/12/83		24.0			8.0		0.0						

WELL NO	DEPTH m	DATE	TEMP °C	PH pH	COND mS/m	CL g/m3	SO4 g/m3	HCO3 g/m3	CO2 g/m3	NAD g/m3	KD g/m3	MGD g/m3	FED g/m3	NO3	MN
M352242		6/07/81		10.9		19.6	2.0		4.0						
		2/04/86		12.6	13.0	16.0	2.5		0.0						
		8/06/87		12.4	12.0	14.5	2.3		6.0						
		14/11/88		12.7	14.0				5.0						
		30/03/89		12.4			2.8		6.0						
		31/10/89		12.8	14.0				0.0						
		16/12/90		12.6	15.0				6.0						
		19/12/91							2.5						
		15/07/92		12.9			2.8		6.0						
		3/12/92		13.0					3.4						
		7/01/93		13.0		18.0	2.6	0.1	3.4						
		17/11/93		12.7			2.5		3.2						
		3/03/94		12.0			2.8	0.1	3.4						
		19/10/94		12.2			3.0		2.5						
		23/11/95		12.5					3.2			9.3			
		20/11/96		13.0					4.4			9.6			
M356038		15/02/89	1	17.0			2.5	0.0	0.0	0.0					
		20/04/89	0.3	13.0			2.5	0.0	3.3	0.0					
		14/11/89	140	18.5	19.2	14.1	0.2	0.0	2.5				0.03		
		7/01/93		12.0		17.0	2.3	0.1	3.4						
		3/03/94		12.0			2.5	0.1	3.3						
		7/02/95		12.0		20.0	2.7	0.1	2.5						
		24/01/96		11.5		19.0		0.1	2.9			9.0			
		18/11/96		12.5		20.0		0.1	3.0			8.8			
M363769		7/07/87	16			230.0	41.0			120.0	2.9	37.0	0.14		
M351476	25	1/07/64		7.0		5.0		44.0				1.0			
		27/06/73		7.6		4.0	4.0	44.0	2.0	6.9	0.6	1.0	0.00	0.10	0.00
		20/07/81		7.2	9.7	3.5	7.0	49.0		4.7	0.7	2.0	0.00	0.50	0.00
		14/08/85		7.3	9.8	3.0	4.8	51.0	4.0	5.6	0	1.6	0.00	0.50	0.00
		18/04/88	12.5	7.3	10.2	3.0	6.0	55.0	5.0	5.2	0.74	1.8		0.70	0.00
		18/04/88	13	7.2	11.3	3.0	7.0	56.0	6.0	5.1	0.78	2.3			
		12/07/88	13	7.3	11.1	4.0	6.0	57.0	6.0	4.9	0.83	2.2	0.00		
		30/03/89	13	7.2	11.5	3.0	10.0			12.0	1.3	5.7	0.00	0.70	0.00

WELL NO	DEPTH m	DATE	TEMP °C	PH pH	COND mS/m	CL g/m3	SO4 g/m3	HCO3 g/m3	CO2 g/m3	NAD g/m3	KD g/m3	MGD g/m3	FED g/m3	NO3	MN
M360892	23.2	14/03/61		7.2		7.0							0.16		0.00
		29/03/61											2.40		
		19/07/77		6.8	28.0	28.0	17.0	76.0	14.0	20.0	1.5	9.0	0.25	4.05	
		20/03/87		6.8	22.1	12.0	12.0						0.00		
		7/12/87	15	6.9	21.8	11.0	13.0								
		22/04/88		7.2	13.8	7.0	8.0	64.0	7.0	8.6	0.95	2.6			
		3/04/89	13.5	6.8	20.0	11.0	12.0	76.0	20.0	12.0	1.2	3.5	0.08		
		27/06/89	12.5	6.9	23.6	12.0	14.0								
		5/06/90	12	6.9	23.2	13.0	18.0								
		28/11/90		6.8	22.9	13.0	13.0								
Mean													0.05		0.01

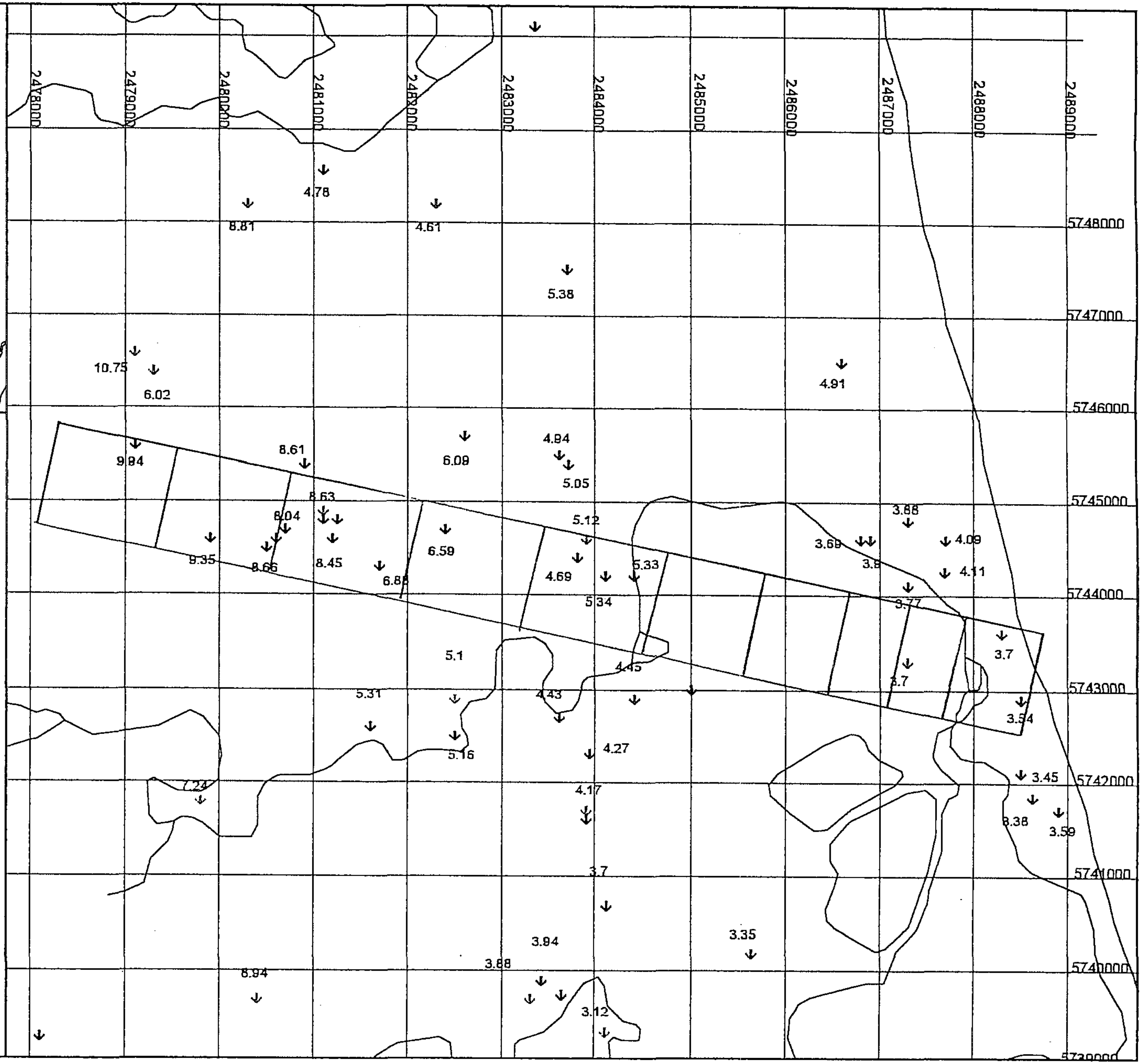
Code	Parameter
TEMP	Temperature
PH	pH
COND	Conductivity
CL	Chloride
SO4	Sulfate
HCO3	Bicarbonate Alkalinity
CO2	Carbonate Alkalinity
NAD	Sodium Dissolved
KD	Potassium Dissolved
MGD	Magnesium Dissolved
FED	Iron Dissolved
NO3N	Nitrate Nitrogen
MN	Manganese Dissolved

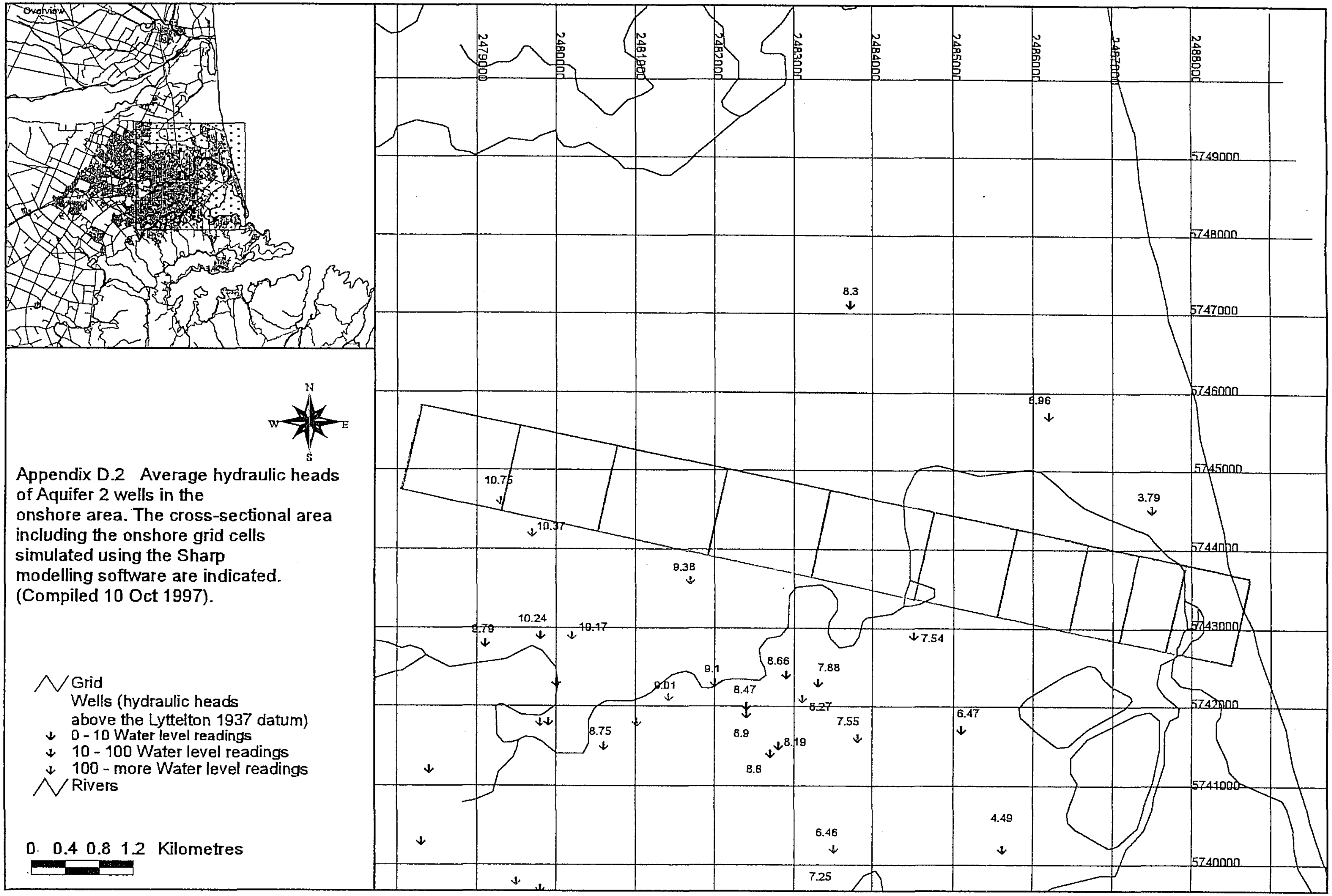


Appendix D.1 Average hydraulic heads of Aquifer 1 monitoring wells in the onshore area. The cross-sectional area including the onshore grid cells simulated using the Sharp modelling software are indicated. (Compiled 10 Oct 1997).

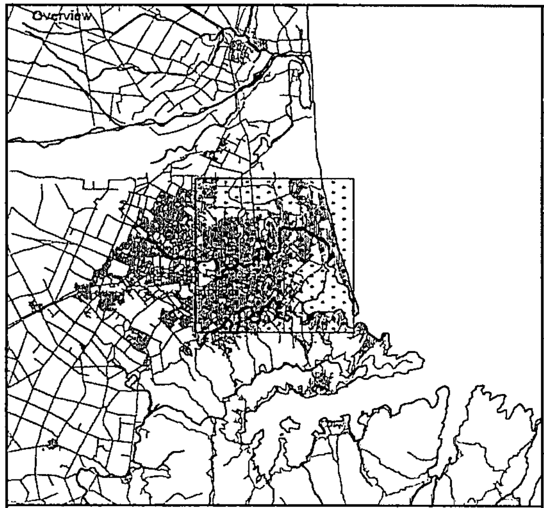
Grid
Wells (hydraulic heads above the Lyttelton 1937 datum)
0 - 10 Water level readings
10 - 100 Water level readings
100 - more Water level readings
Rivers

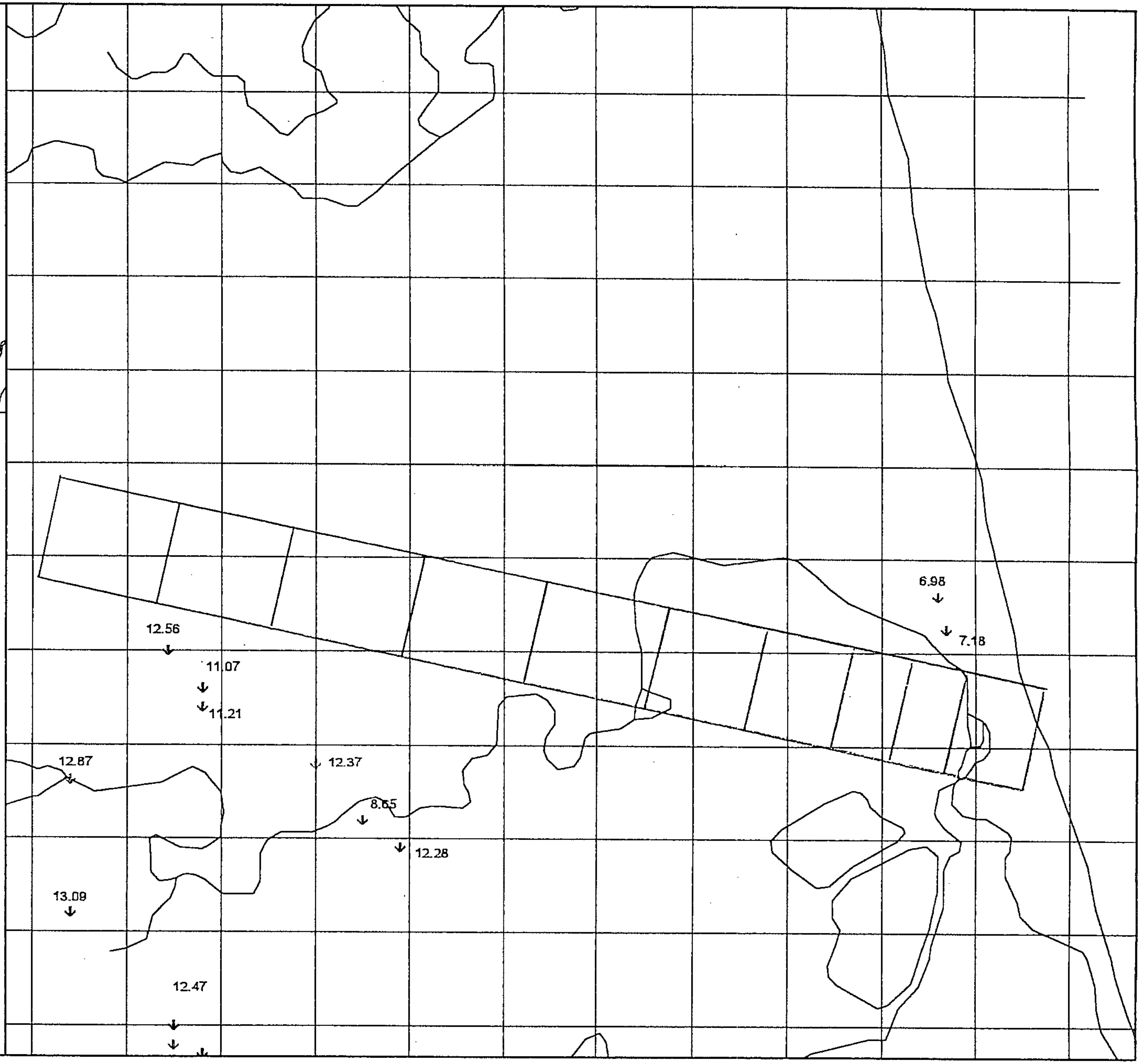
0 0.4 0.8 1.2 Kilometres





Appendix D.2 Average hydraulic heads of Aquifer 2 wells in the onshore area. The cross-sectional area including the onshore grid cells simulated using the Sharp modelling software are indicated. (Compiled 10 Oct 1997).





N
W E
S

Appendix D.3 Average hydraulic heads of Aquifer 3 wells in the onshore area. The cross-sectional area including the onshore grid cells simulated using the Sharp modelling software are indicated. (Compiled 10 Oct 1997).

Grid
Wells (hydraulic heads above the Lyttelton 1937 datum)
- 0 - 10 Water level readings
- 10 - 100 Water level readings
- 100 - more Water level readings

Rivers

0 . 0.4 0.8 1.2 Kilometres

Appendix D.4 INPPUT Christchurch equilibrium solution- cross-sectional model with 3 layers

```
   3   30     3   50    99     6      1     3    20     0     0
   0.0001    0.0001        0.80        0.50     10000.          1       1.025   2.09E-05   2.09E-05
   0        0.0             1
   2     7    1
   2     7    2
   2     7    3
   0 2.000E-03                          FKX
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         1.0         1.0         1.0         1.0         1.0         1.0         1.0         1.0         1.0
      1.0         1.0         1.0         1.0         1.0         1.0         1.0         1.0         1.0         1.0
      1.0         1.0         1.0         1.0         1.0         1.0         1.0         1.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
   1        1.0                         FKY
   0        1.0                         STORF-1
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0        -1.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
   1        0.0                         STORS-1
   1    1.0E-04                         POR
   1       10.0                         THCK
   1     -105.0                         ZBOT
   0        1.0    PHIF LAYER  1
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       13.50       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
   0  1.40E-09     1                    AQL (LEAKANCES)
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       1.000       1.000       1.000       1.000       1.000       1.000       1.000       1.000       1.000
    1.000       1.000       1.000       1.000       1.000       1.000       1.000       1.000       1.000       1.000
    1.000       1.000       1.000       1.000       1.000       1.000       1.000       1.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
   0 1.500E-04                          FKX
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         1.0         1.0         1.0         1.0         1.0         1.0         1.0         1.0         1.0
      1.0         1.0         1.0         1.0         1.0         1.0         1.0         1.0         1.0         1.0
      1.0         1.0         1.0         1.0         1.0         1.0         1.0         1.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
   1        1.0                         FKY
   0        1.0                         STORF-2
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0        -1.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
      0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0         0.0
   1        0.0                         STORS-2
   1    1.0E-04
   1       30.0
   1      -90.0
   0        1.0    PHIF LAYER  2,
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       11.50       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
   0  0.97E-09                          AQL
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.500       0.500       0.500       0.500       0.500       0.500       0.500       0.500       0.500
    0.500       0.500       0.500       0.500       0.500       0.500       0.500       0.500       0.500       0.500
    0.500       0.500       0.500       0.500       0.500       0.500       0.500       0.500       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
    0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000       0.000
```

```
0 1.500E-03                             FKX
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        1.0        1.0        1.0        1.0        1.0        1.0        1.0        1.0        1.0
     1.0        1.0        1.0        1.0        1.0        1.0        1.0        1.0        1.0        1.0
     1.0        1.0        1.0        1.0        1.0        1.0        1.0        1.0        1.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
1        1.0                            FKY
0        1.0                            STORF-3
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0       -1.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
0        1.0                            STORS-3
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0       -1.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
1   1.0E-04
0       15.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        1.3        1.3        1.0        1.0        1.0        1.0        1.0        1.0        1.0
     1.0        1.0        1.0        1.0        1.0        1.0        1.0        1.0        1.0        1.0
     1.0        1.0        1.0        1.0        1.0        1.0        1.0        1.0        1.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
1      -50.0
0        1.0    PHIF LAYER  3,
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      9.940      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
0  0.90E-07                             AQL
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.050      0.050      0.040      0.033      0.029      0.029      0.025      0.025      0.025
   0.025      0.026      0.026      0.027      0.029      0.029      0.029      0.033      0.033      0.033
   0.033      0.033      0.033      0.033      0.033      0.033      0.033      0.033      10000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
0        1.0                            HEAD (FIXED FRESHWATER HEAD IN OVERLYING LAYER)
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      9.940      9.350      8.450      6.590      5.340      4.800      4.200      3.700      3.600
   3.555      0.025      0.050      0.075      0.125      0.125      0.125      0.250      0.250      0.250
   0.250      0.250      0.250      0.250      0.250      0.250      0.250      0.250      1.250      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
   0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
0        1.0                            BATH
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
   0.000        -1.        -2.        -3.        -5.        -5.        -5.       -10.       -10.       -10.
    -10.       -10.       -10.       -10.       -10.       -10.       -10.       -10.       -50.        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
     0.0        0.0        0.0        0.0        0.0        0.0        0.0        0.0
0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0    0    0
0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0    0    0
0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0    0    0
   1280.      1280.      1280.      1280.      1280.      1280.      1000.       870.       660.       500.
    570.       660.       760.       870.      1000.      1140.      1310.      1510.      1730.      1990.
   2280.      2620.      3010.      3450.      3960.      4550.      4580.      4580.      4580.      5000.
   1000.      1000.      1000.
5486560.       1.30   3652500.     99     0
1        0.0
```

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-------------------------------------------------------------------------------------
    CHRISTCHURCH EQUILIBRIUM SOLUTION - CROSS-SECTIONAL MODEL WITH 3 LAYER
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NUMBER OF ROWS=   3
NUMBER OF COLUMNS=  30
NUMBER OF  AQUIFERS=   3
NUMBER OF TIME STEPS BETWEEN PRINTOUT=  50
MAXIMUM NUMBER OF ITERATIONS=  99
NUMBER OF ITERATION PARAMETERS=   6
NUMBER OF PUMPING PERIODS=   1
INTERFACE FIXED AFTER   20 ITERATIONS
INPUT/OUTPUT OPTIONS' PARAMETER=   0 (0=USE DEFAULTS, 1=READ IN OPTIONS ARRAY)
LEAKAGE OPTION PARAMETER=   0 (0=RESTRICTED MIXING, 1=COMPLETE MIXING)

CONVERGENCE CRITERION= 0.1000E-03
STEADY STATE CRITERION= 0.1000E-03
RELAXATION FACTOR= 0.8000
WEIGHTING FACTOR= 0.5000
ITERATION PARAMETER FACTOR= 0.1000E+05
SPECIFIC GRAVITY OF FRESHWATER=  1.000
SPECIFIC GRAVITY OF SALTWATER=  1.025
VISCOSITY OF FRESHWATER= 0.2090E-04
VISCOSITY OF SALTWATER= 0.2090E-04


NEW RUN
   INTERFACE ELEVATIONS INITIALIZED TO -DEL*PHIF

LOCATIONS OF     3 OBSERVATION NODES TRACKED:
   2    7    1
   2    7    2
   2    7    3

SPECIFIED INPUT/OUTPUT OPTIONS:

   1: 1=PRINT INPUT AQUIFER PARAMETERS, 0=DO NOT PRINT
   1: 1=PRINT INPUT PUMPING PERIOD WELL AND RECHARGE DATA, 0=DO NOT PRINT
   1: 1=PRINT CALCULATED FRESHWATER HEADS, 0=DO NOT PRINT
   1: 1=PRINT CALCULATED SALTWATER HEADS, 0=DO NOT PRINT
   1: 1=PRINT CALCULATED INTERFACE ELEVATIONS, 0=DO NOT PRINT
   0: 1=PRINT CALCULATED FAREA FACTORS, 0=DO NOT PRINT
   0: 1=PRINT CALCULATED SAREA FACTORS, 0=DO NOT PRINT
   1: 1=PRINT F-M-S MAP, 0=DO NOT PRINT
   1: 1=WRITE BLOCK LEAKAGE VALUES TO FILE, 0=DO NOT WRITE TO FILE
   0: 1=PRINT ITERATION INFORMATION TO SCREEN, 0=DO NOT PRINT
   0: 0=REWRITE LATEST RESULTS TO FILE AFTER EACH TIME STEP,
      1=WRITE RESULTS TO FILE EVERY NP TIME STEPS

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AQUIFER PARAMETERS FOR LAYER  1
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HYDRAULIC CONDUCTIVITY OF FRESHWATER IN X-DIRECTION
   1     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
   2     0.0000     0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02
         0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02
         0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.2000E-02 0.0000     0.0000
   3     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

HYDRAULIC CONDUCTIVITY OF FRESHWATER IN Y-DIRECTION

  1.000

FRESHWATER SPECIFIC STORAGE
   1     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
   2     0.0000     -1.000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
   3     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

SALTWATER SPECIFIC STORAGE

 0.0000

EFFECTIVE POROSITY

 0.1000E-03

AQUIFER THICKNESS

  10.00

ELEVATION OF BASE OF AQUIFER

 -105.0

INITIAL FRESHWATER HEAD
   1     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
   2     0.0000      13.50     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
   3     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

INITIAL INTERFACE ELEVATION
   1     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
```

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	-540.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

INITIAL SALTWATER HEADS

1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.4484E-15	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AQUITARD LEAKANCES (K"/B")

1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08
	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08
	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.1400E-08	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AQUIFER PARAMETERS FOR LAYER 2

HYDRAULIC CONDUCTIVITY OF FRESHWATER IN X-DIRECTION

1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03
	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03
	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.1500E-03	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

HYDRAULIC CONDUCTIVITY OF FRESHWATER IN Y-DIRECTION

1.000

FRESHWATER SPECIFIC STORAGE

1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	-1.000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

SALTWATER SPECIFIC STORAGE

0.0000

EFFECTIVE POROSITY

0.1000E-03

AQUIFER THICKNESS

30.00

ELEVATION OF BASE OF AQUIFER

-90.00

INITIAL FRESHWATER HEAD

1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	11.50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

INITIAL INTERFACE ELEVATION

1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	-460.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

INITIAL SALTWATER HEADS

1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.3305E-15	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AQUITARD LEAKANCES (K"/B")

```
  1    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
  2    0.0000     0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09
       0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09
       0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.4850E-09 0.0000     0.0000
  3    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

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AQUIFER PARAMETERS FOR LAYER  3
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HYDRAULIC CONDUCTIVITY OF FRESHWATER IN X-DIRECTION
  1    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
  2    0.0000     0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02
       0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02
       0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.0000
  3    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

HYDRAULIC CONDUCTIVITY OF FRESHWATER IN Y-DIRECTION

   1.000

FRESHWATER SPECIFIC STORAGE
  1    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
  2    0.0000     -1.000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
  3    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

SALTWATER SPECIFIC STORAGE
  1    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
  2    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     -1.000     0.0000     0.0000     0.0000
  3    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

EFFECTIVE POROSITY

 0.1000E-03

AQUIFER THICKNESS
  1    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
  2    0.0000      19.50      19.50      15.00      15.00      15.00      15.00      15.00      15.00      15.00
        15.00      15.00      15.00      15.00      15.00      15.00      15.00      15.00      15.00      15.00
        15.00      15.00      15.00      15.00      15.00      15.00      15.00      15.00      15.00     0.0000
  3    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

ELEVATION OF BASE OF AQUIFER

 -50.00

INITIAL FRESHWATER HEAD
  1    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
  2    0.0000      9.940     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
  3    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

INITIAL INTERFACE ELEVATION
  1    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
  2    0.0000     -397.6     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
  3    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

INITIAL SALTWATER HEADS
  1    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
  2    0.0000     0.7234E-15 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
  3    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

AQUITARD LEAKANCES (K"/B")
  1    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
  2    0.0000     0.4500E-08 0.4500E-08 0.3600E-08 0.2970E-08 0.2610E-08 0.2610E-08 0.2250E-08 0.2250E-08 0.2250E-08
       0.2250E-08 0.2340E-08 0.2340E-08 0.2430E-08 0.2610E-08 0.2610E-08 0.2610E-08 0.2970E-08 0.2970E-08 0.2970E-08
       0.2970E-08 0.2970E-08 0.2970E-08 0.2970E-08 0.2970E-08 0.2970E-08 0.2970E-08 0.2970E-08 0.9000E-03 0.0000
```

```
   3    0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
        0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
        0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000

 HEAD IN OVERLYING AQUIFER
   1    0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
        0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
        0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
   2    0.0000      9.940       9.350       8.450       6.590       5.340       4.800       4.200       3.700       3.600
         3.555      0.2500E-01 0.5000E-01 0.7500E-01 0.1250      0.1250      0.1250      0.2500      0.2500      0.2500
        0.2500      0.2500      0.2500      0.2500      0.2500      0.2500      0.2500      0.2500       1.250      0.0000
   3    0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
        0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
        0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000

 BATHYMETRY
   1    0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
        0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
        0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
   2    0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
        0.0000      -1.000      -2.000      -3.000      -5.000      -5.000      -5.000      -10.00      -10.00      -10.00
        -10.00      -10.00      -10.00      -10.00      -10.00      -10.00      -10.00      -10.00      -50.00      0.0000
   3    0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
        0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
        0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000

CODE FOR UPPER LAYER (1-UNCONFINED NODE,0-CONFINED NODE)
   1        0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
            0    0    0    0    0
   2        0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
            0    0    0    0    0
   3        0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
            0    0    0    0    0

 DELTA X

  1280.       1280.       1280.       1280.       1280.       1280.       1000.       870.0       660.0       500.0
  570.0       660.0       760.0       870.0       1000.       1140.       1310.       1510.       1730.       1990.
  2280.       2620.       3010.       3450.       3960.       4550.       4580.       4580.       4580.       5000.

 DELTA Y

  1000.       1000.       1000.

 ITERATION PARAMETERS:
   FRESHWATER EQUATION:.0000     .7917     .9566     .9910     .9981     .9996


 ----------------------------------------------------------------------------------------
                                PUMPING PERIOD  1
 ----------------------------------------------------------------------------------------

                     INITIAL TIME STEP(SEC)= 0.5487E+07
                     MULTIPLICATION FACTOR FOR DELTA T=  1.300
                     LENGTH OF PUMPING PERIOD(DAYS)= 0.3653E+07
                     MAXIMUM NUMBER OF TIME STEPS= 99
                     NUMBER OF ACTIVE WELLS=  0

 RECHARGE

  0.0000

 -------------
 TIME STEP   1
 -------------
                            SECONDS       HOURS        DAYS         YEARS
   TIME STEP SIZE:          0.5487E+07  1524.        63.50        0.1739
   PUMPING PERIOD TIME:     0.5487E+07  1524.        63.50        0.1739
   TOTAL SIMULATION TIME:   0.5487E+07  1524.        63.50        0.1739

 MAXIMUM FRESHWATER HEAD CHANGE:  10.48       9.534       6.488       6.086       4.382       6.412       3.779       7.451
                                   5.156       7.663       5.231       5.882       3.696       5.375       5.599       5.874
                                   6.389       4.527       4.443       5.808       2.342       0.3291      0.5704      0.4555E-01
                                  0.1052E-01 0.1912E-01 0.1264E-01 0.4323E-02 0.4227E-02 0.3038E-03 0.1276E-03 0.1530E-03
                                  0.7767E-04
 MAXIMUM SALTWATER HEAD CHANGE:   3.192       4.214       1.429       1.157       2.232       0.5040      0.9926      1.408
                                   1.297       0.4385      0.6930      0.3183      0.2374       1.900       2.335       2.494
                                   2.965       1.164       0.7706       2.205       1.770       0.8117      0.3542      0.2457
                                  0.6034E-01 0.3341E-01 0.5892E-02 0.9591E-02 0.2316E-02 0.1825E-02 0.3719E-03 0.2653E-03
                                  0.4918E-04

 -------------
 TIME STEP   2
 -------------
                            SECONDS       HOURS        DAYS         YEARS
   TIME STEP SIZE:          0.7133E+07  1981.        82.55        0.2260
   PUMPING PERIOD TIME:     0.1262E+08  3505.        146.1        0.3999
   TOTAL SIMULATION TIME:   0.1262E+08  3505.        146.1        0.3999

 MAXIMUM FRESHWATER HEAD CHANGE:  6.049       4.515       5.805       5.873       6.479       4.720       4.756       6.238
                                   6.257       6.499       6.739       4.886       4.937       6.460       6.422       6.668
                                   6.889       5.041       5.148       6.673       2.211       0.3548      0.5908      0.1124
                                  0.3781E-01 0.2713E-01 0.9573E-02 0.4539E-02 0.3584E-02 0.7246E-03 0.2476E-03 0.2047E-03
                                  0.6316E-04
 MAXIMUM SALTWATER HEAD CHANGE:   1.617       0.9761      2.078       2.127       2.752       0.9856      0.8089      2.268
                                   2.377       2.578       2.726       0.8770      0.7149       2.215       2.271       2.477
                                   2.617       0.7591      0.6368       2.144       1.694       1.052       0.3693      0.2436
                                  0.4856E-01 0.3465E-01 0.5973E-02 0.8800E-02 0.2056E-02 0.1575E-02 0.3225E-03 0.2773E-03
                                  0.5654E-04

 -------------
 TIME STEP   3
 -------------
                            SECONDS       HOURS        DAYS         YEARS
   TIME STEP SIZE:          0.9272E+07  2576.        107.3        0.2938
   PUMPING PERIOD TIME:     0.2189E+08  6081.        253.4        0.6937
   TOTAL SIMULATION TIME:   0.2189E+08  6081.        253.4        0.6937

 MAXIMUM FRESHWATER HEAD CHANGE:  7.252       5.583       6.785       6.676       7.289       5.479       5.555       7.119
                                   4.158       7.116       5.275       5.297       2.897       4.729       4.662       5.185
```

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                                     5.372       3.651       3.654       4.891       1.591       0.1989      0.4110      0.1292
                                     0.3373E-01  0.1602E-01  0.6613E-02  0.2672E-02  0.2200E-02  0.8585E-03  0.1855E-03  0.9558E-04
                                     0.2606E-04
MAXIMUM SALTWATER HEAD CHANGE:       1.575       1.097       2.084       2.008       2.735       0.8359      0.5400      2.136
                                     0.9112      1.780       1.283       0.2743      0.2033      1.804       1.881       2.304
                                     2.442       0.8376      0.6156      1.816       1.332       0.6706      0.2728      0.1869
                                     0.3654E-01  0.2068E-01  0.3303E-02  0.5547E-02  0.1296E-02  0.1030E-02  0.2050E-03  0.1119E-03
                                     0.1786E-04

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TIME STEP   4
-------------
                            SECONDS      HOURS      DAYS       YEARS
  TIME STEP SIZE:           0.1205E+08   3348.      139.5      0.3820
  PUMPING PERIOD TIME:      0.3395E+08   9429.      392.9      1.076
  TOTAL SIMULATION TIME:    0.3395E+08   9429.      392.9      1.076

MAXIMUM FRESHWATER HEAD CHANGE:      5.121       3.906       4.995       5.237       5.788       4.024       4.102       5.414
                                     5.393       5.913       6.092       4.051       4.081       5.539       5.489       6.030
                                     6.523       4.377       4.154       5.704       1.841       0.3059      0.4364      0.2001
                                     0.4253E-01  0.1298E-01  0.4077E-02  0.2304E-02  0.8319E-03  0.3140E-03  0.2618E-04  0.3527E-04
MAXIMUM SALTWATER HEAD CHANGE:       1.282       0.8299      2.024       2.114       2.720       1.040       0.8001      2.105
                                     2.371       2.721       2.651       0.8255      0.7024      2.104       2.350       2.719
                                     3.089       1.096       0.5509      2.087       1.518       0.8291      0.2829      0.1932
                                     0.3766E-01  0.1549E-01  0.2159E-02  0.2798E-02  0.4331E-03  0.5105E-03  0.1767E-03  0.8499E-04

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TIME STEP   5
-------------
                            SECONDS      HOURS      DAYS       YEARS
  TIME STEP SIZE:           0.1567E+08   4353.      181.4      0.4966
  PUMPING PERIOD TIME:      0.4962E+08   0.1378E+05 574.3      1.572
  TOTAL SIMULATION TIME:    0.4962E+08   0.1378E+05 574.3      1.572

MAXIMUM FRESHWATER HEAD CHANGE:      5.866       4.350       5.149       5.379       5.955       4.213       4.430       5.734
                                     6.324       7.022       6.731       4.372       4.380       3.812       2.447       5.538
                                     4.477       4.513       2.739       2.413       1.587       0.3619      0.5556E-01  0.5103E-01
                                     0.2001E-01  0.1879E-01  0.2708E-02  0.5721E-02  0.1036E-02  0.8093E-03  0.5509E-03  0.3802E-03
                                     0.1557E-03  0.4837E-04
MAXIMUM SALTWATER HEAD CHANGE:       1.190       0.6801      1.611       1.684       2.297       0.6558      0.5870      1.877
                                     3.072       3.470       2.517       3.137       0.2395      0.6116      0.2503      1.196
                                     0.8373      0.1345      0.3069      0.7601      0.2473      0.1960      0.6663E-01  0.4462E-01
                                     0.1779E-01  0.2373E-01  0.6344E-02  0.4010E-02  0.5051E-03  0.4517E-03  0.2495E-03  0.3112E-03
                                     0.1050E-03  0.5520E-04

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TIME STEP   6
-------------
                            SECONDS      HOURS      DAYS       YEARS
  TIME STEP SIZE:           0.2037E+08   5659.      235.8      0.6455
  PUMPING PERIOD TIME:      0.6999E+08   0.1944E+05 810.0      2.218
  TOTAL SIMULATION TIME:    0.6999E+08   0.1944E+05 810.0      2.218

MAXIMUM FRESHWATER HEAD CHANGE:      3.093       4.013       1.428       2.910       1.706       2.510       1.744       2.128
                                     1.047       0.4376      1.304       1.036       0.9369      1.624       1.367       1.716
                                     1.169       1.198       1.899       0.7791      0.6640      0.9157      0.8172      1.050
                                     0.2911      0.1177      0.8814E-01  0.5329E-01  0.1783E-01  0.1691E-01  0.2315E-01  0.6201E-02
                                     0.5039E-02  0.2103E-02  0.8200E-03  0.8363E-03  0.1012E-02  0.2182E-03  0.1810E-03  0.4737E-04
MAXIMUM SALTWATER HEAD CHANGE:       0.6243      0.2499      0.1090      0.8092E-01  0.1288      0.2176      0.4527      0.2525
                                     0.7938      0.4750      0.1331      0.1390      0.3960      1.322       0.2902      1.373
                                     0.7842      0.5867      0.1951      0.6081      0.7718      0.8426      0.7377      0.5320
                                     0.2721      0.6120E-01  0.1673E-01  0.3544E-01  0.4175E-02  0.1221E-01  0.1268E-01  0.3227E-02
                                     0.1130E-02  0.1795E-02  0.3738E-03  0.6901E-03  0.5730E-03  0.1307E-03  0.5152E-04  0.4155E-04

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TIME STEP   7
-------------
                            SECONDS      HOURS      DAYS       YEARS
  TIME STEP SIZE:           0.2648E+08   7356.      306.5      0.8392
  PUMPING PERIOD TIME:      0.9647E+08   0.2680E+05 1117.      3.057
  TOTAL SIMULATION TIME:    0.9647E+08   0.2680E+05 1117.      3.057

MAXIMUM FRESHWATER HEAD CHANGE:      0.9447      0.9776      1.888       2.408       2.026       2.103       0.4919      0.1708
                                     0.9657      0.2839      0.6265      1.181       0.3254      0.1642      0.4100      1.710
                                     1.251       1.613       0.1558      0.7608      3.744       4.177       4.818       1.611
                                     1.154       0.3127      0.3089      0.1432      0.3234E-01  0.2232E-01  0.3094E-02  0.2671E-02
                                     0.2040E-02  0.6180E-03  0.1482E-03  0.9472E-04
MAXIMUM SALTWATER HEAD CHANGE:       0.4721      0.1433      0.5347      1.102       1.258       0.6796      0.3083      0.1552
                                     0.2551      0.4127      0.3007      0.4404      0.7717E-01  0.1463      0.2215      1.008
                                     0.7192      0.5885      0.4338      0.4367      4.139       2.734       0.9621      0.4377
                                     0.5422      0.2011      0.1208      0.3499E-01  0.2220E-01  0.8708E-02  0.1809E-02  0.9012E-03
                                     0.6346E-03  0.1152E-03  0.6176E-04  0.2508E-04

-------------
TIME STEP   8
-------------
                            SECONDS      HOURS      DAYS       YEARS
  TIME STEP SIZE:           0.3443E+08   9563.      398.5      1.091
  PUMPING PERIOD TIME:      0.1309E+09   0.3636E+05 1515.      4.148
  TOTAL SIMULATION TIME:    0.1309E+09   0.3636E+05 1515.      4.148

MAXIMUM FRESHWATER HEAD CHANGE:      0.9190      0.2618      0.7869      0.9514      6.199       3.438       1.687       0.8664
                                     0.2356      0.3048      0.2766      0.3084      0.2447E-01  0.3289      0.5720E-01  0.1458
                                     0.8349E-01  0.3149E-01  0.1186E-01  0.1657E-01  0.7683E-02  0.2814E-02  0.3314E-02  0.4876E-03
                                     0.3153E-03  0.1235E-03  0.1053E-03  0.1693E-04
MAXIMUM SALTWATER HEAD CHANGE:       0.5565      0.1835      0.9635E-01  0.4626      1.513       1.413       0.1678      0.2655
                                     1.076       0.7391E-01  0.3565      0.2210      0.2173      0.8019E-01  0.3614      0.5049E-01
                                     0.4178E-01  0.9118E-02  0.2434E-02  0.2192E-02  0.3182E-02  0.1623E-02  0.1090E-02  0.1121E-02
                                     0.3549E-03  0.1064E-03  0.3080E-04  0.2892E-04

-------------
TIME STEP   9
-------------
                            SECONDS      HOURS      DAYS       YEARS
  TIME STEP SIZE:           0.4476E+08   0.1243E+05 518.0      1.418
  PUMPING PERIOD TIME:      0.1757E+09   0.4879E+05 2033.      5.566
  TOTAL SIMULATION TIME:    0.1757E+09   0.4879E+05 2033.      5.566

MAXIMUM FRESHWATER HEAD CHANGE:      0.9055E-01  0.4488      0.1364      0.4361E-01  0.1452E-01  0.1147E-01  0.1098E-02  0.1925E-02
                                     0.4419E-03  0.2452E-02  0.8070E-03  0.7452E-03  0.1973E-03  0.1378E-03  0.3049E-04
```

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MAXIMUM SALTWATER HEAD CHANGE:  0.7845E-01 0.3479E-01 0.2765E-01 0.8490E-02 0.2288E-02 0.6285E-03 0.8761E-03 0.3168E-03
                                 0.2007E-03 0.3114E-03 0.7186E-04 0.8621E-04 0.5171E-04 0.6276E-04 0.1140E-04

-------------
TIME STEP  10
-------------
                             SECONDS      HOURS      DAYS        YEARS
  TIME STEP SIZE:          0.5818E+08 0.1616E+05  673.4       1.844
  PUMPING PERIOD TIME:     0.2338E+09 0.6495E+05  2706.       7.410
  TOTAL SIMULATION TIME:  0.2338E+09 0.6495E+05  2706.       7.410

MAXIMUM FRESHWATER HEAD CHANGE: 0.1825E-01 0.2237E-01 0.7561E-02 0.9897E-02 0.9797E-02 0.9373E-02 0.6084E-02 0.4064E-02
                                 0.3421E-02 0.3182E-02 0.1770E-02 0.2376E-02 0.1284E-02 0.7013E-03 0.8026E-03 0.7673E-03
                                 0.4108E-03 0.5194E-03 0.2653E-03 0.1286E-03 0.5828E-04
MAXIMUM SALTWATER HEAD CHANGE:  0.1741E-01 0.1065E-01 0.4701E-02 0.4599E-02 0.1755E-02 0.1877E-02 0.4763E-03 0.1923E-02
                                 0.5590E-03 0.1674E-02 0.3717E-03 0.1781E-03 0.1458E-03 0.4614E-03 0.1184E-03 0.3069E-03
                                 0.6858E-04 0.3137E-04 0.4449E-04 0.1144E-03 0.1599E-04

-------------
TIME STEP  11
-------------
                             SECONDS      HOURS      DAYS        YEARS
  TIME STEP SIZE:          0.7564E+08 0.2101E+05  875.4       2.397
  PUMPING PERIOD TIME:     0.3095E+09 0.8596E+05  3582.       9.807
  TOTAL SIMULATION TIME:  0.3095E+09 0.8596E+05  3582.       9.807

MAXIMUM FRESHWATER HEAD CHANGE: 0.2722E-02 0.3057E-02 0.2786E-02 0.2552E-02 0.2410E-02 0.2273E-02 0.1471E-02 0.9343E-03
                                 0.1139E-02 0.9755E-03 0.5711E-03 0.7091E-03 0.4130E-03 0.2257E-03 0.3409E-03 0.2973E-03
                                 0.1629E-03 0.2020E-03 0.1180E-03 0.5817E-04
MAXIMUM SALTWATER HEAD CHANGE:  0.3473E-02 0.1724E-02 0.9908E-03 0.1273E-02 0.4944E-03 0.4626E-03 0.1104E-03 0.4559E-03
                                 0.1713E-03 0.4801E-03 0.1254E-03 0.7344E-04 0.4580E-04 0.1541E-03 0.5157E-04 0.1282E-03
                                 0.3223E-04 0.1046E-04 0.1575E-04 0.4745E-04

-------------
TIME STEP  12
-------------
                             SECONDS      HOURS      DAYS        YEARS
  TIME STEP SIZE:          0.9833E+08 0.2731E+05  1138.       3.116
  PUMPING PERIOD TIME:     0.4078E+09 0.1133E+06  4720.       12.92
  TOTAL SIMULATION TIME:  0.4078E+09 0.1133E+06  4720.       12.92

MAXIMUM FRESHWATER HEAD CHANGE: 0.3289E-03 0.3764E-03 0.3570E-03 0.3156E-03 0.3102E-03 0.2861E-03 0.1930E-03 0.1235E-03
                                 0.1599E-03 0.1361E-03 0.8611E-04
MAXIMUM SALTWATER HEAD CHANGE:  0.4552E-03 0.2200E-03 0.1286E-03 0.1637E-03 0.6495E-04 0.6550E-04 0.1138E-04 0.5517E-04
                                 0.2344E-04 0.6601E-04 0.1742E-04

-------------
TIME STEP  13
-------------
                             SECONDS      HOURS      DAYS        YEARS
  TIME STEP SIZE:          0.1278E+09 0.3551E+05  1479.       4.051
  PUMPING PERIOD TIME:     0.5356E+09 0.1488E+06  6199.       16.97
  TOTAL SIMULATION TIME:  0.5356E+09 0.1488E+06  6199.       16.97

MAXIMUM FRESHWATER HEAD CHANGE: 0.1120E-03 0.1015E-03 0.8365E-04
MAXIMUM SALTWATER HEAD CHANGE:  0.3822E-04 0.1667E-04 0.1804E-04

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STEADY STATE ACHIEVED AT:
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TIME STEP  14
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                             SECONDS      HOURS      DAYS        YEARS
  TIME STEP SIZE:          0.1662E+09 0.4616E+05  1923.       5.266
  PUMPING PERIOD TIME:     0.7018E+09 0.1949E+06  8123.       22.24
  TOTAL SIMULATION TIME:  0.7018E+09 0.1949E+06  8123.       22.24

MAXIMUM FRESHWATER HEAD CHANGE: 0.3581E-04
MAXIMUM SALTWATER HEAD CHANGE:  0.2139E-04

AQUIFER   1
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     MASS BALANCE:
                                       FRESHWATER                          SALTWATER
                                 T.S. RATE   CUM. VOLUME           T.S. RATE   CUM. VOLUME
        CHANGE IN STORAGE       -0.1090E-08 0.8509E+05            0.1090E-08-0.8509E+05
         SOURCES
           RECHARGE               0.0000      0.0000
           CONSTANT HEAD NODES    0.2388E-01 0.1659E+08             0.0000      0.0000
           INJECTION              0.0000      0.0000                0.0000      0.0000
           FW LEAKAGE ACROSS TOP  0.0000      0.0000                0.0000      0.0000
           FW LEAKAGE ACROSS BOT  0.0000      0.0000                0.0000      0.0000
           SW LEAKAGE ACROSS TOP  0.0000      0.0000                0.2900E-04 0.2355E+05
           SW LEAKAGE ACROSS BOT  0.0000      0.0000                0.0000      0.0000
           TOTAL                  0.2388E-01 0.1659E+08             0.2900E-04 0.2355E+05
         SINKS
           CONSTANT HEAD NODES    0.0000      0.0000                0.0000      0.0000
           PUMPAGE                0.0000      0.0000                0.0000      0.0000
           LEAKAGE ACROSS TOP     0.2389E-01 0.1644E+08             0.2898E-04 0.2401E+06
           LEAKAGE ACROSS BOT     0.0000      0.0000                0.0000      0.0000
           TOTAL                  0.2389E-01 0.1644E+08             0.2898E-04 0.2401E+06
         SOURCES-SINKS           -0.9713E-07 0.1460E+06             0.1907E-07-0.2166E+06
       RELATIVE ERROR (%)
           INFLUX                 0.4021E-03-0.3670                -0.6199E-01  558.4
           STORAGE               -8813.      -71.55                 -1649.      -154.5

FRESHWATER HEADS
   1     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2     11111.     13.500     12.201     11.040     9.9769     8.9960     8.1899     7.5714     7.0959     6.7532
         6.4497     6.1175     5.7570     5.3735     4.9735     4.5668     4.1633     3.7721     3.4063     3.0792
         2.8064     2.6079     2.4426     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

SALTWATER HEADS
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   1     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.    0.21946E-010.21945E-010.19766E-010.14527E-010.94752E-020.61411E-020.47072E-02 11111.     11111.
   3     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

INTERFACE ELEVATION
   1     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.    -103.42     -96.805     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

MAP OF EXTENT OF INTRUSION (F-FRESHWATER, M-FRESH AND SALTWATER, S-SALTWATER)

   1     . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
   2     . F F F F F F F F F F F F F F F F F F F F M M S S S S S . .
   3     . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

AQUIFER   2
-----------
    MASS BALANCE:
                                        FRESHWATER                         SALTWATER
                                   T.S. RATE  CUM. VOLUME          T.S. RATE   CUM. VOLUME
        CHANGE IN STORAGE         -0.1042E-09 0.8527E+05           0.1042E-09-0.8527E+05
         SOURCES
           RECHARGE                0.0000     0.0000
           CONSTANT HEAD NODES     0.2746E-02 0.1897E+07            0.0000     0.0000
           INJECTION               0.0000     0.0000                0.0000     0.0000
           FW LEAKAGE ACROSS TOP   0.0000     0.0000                0.0000     0.0000
           FW LEAKAGE ACROSS BOT   0.2387E-01 0.1642E+08            0.1954E-04 0.2801E+05
           SW LEAKAGE ACROSS TOP   0.0000     0.0000                0.2095E-04 0.1093E+05
           SW LEAKAGE ACROSS BOT   0.0000     0.0000                0.2898E-04 0.2401E+06
           TOTAL                   0.2661E-01 0.1831E+08            0.6947E-04 0.2790E+06
         SINKS
           CONSTANT HEAD NODES     0.3584E-02 0.2515E+07            0.0000     0.0000
           PUMPAGE                 0.0000     0.0000                0.0000     0.0000
           LEAKAGE ACROSS TOP      0.2303E-01 0.1571E+08            0.4046E-04 0.3408E+06
           LEAKAGE ACROSS BOT      0.0000     0.0000                0.2900E-04 0.2355E+05
           TOTAL                   0.2661E-01 0.1823E+08            0.6946E-04 0.3643E+06
         SOURCES-SINKS            -0.1032E-06 0.8524E+05            0.1478E-07-0.8526E+05
        RELATIVE ERROR (%)
           INFLUX                  0.3875E-03 0.1586E-03           -0.2113E-01-0.9517E-03
           STORAGE                -0.9894E+05 0.3407E-01           -0.1408E+05 0.3115E-02

FRESHWATER HEADS
   1     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2     11111.     11.500     10.995     10.185     9.2630     8.3335     7.5390     6.9168     6.4315     6.0788
         5.7651     5.4219     5.0540     4.6732     4.2923     3.9306     3.5970     3.2837     2.9939     2.7340
         2.5133     2.3371     2.1727     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

SALTWATER HEADS
   1     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.    0.35314E-010.22909E-010.13689E-010.80052E-020.48069E-020.37062E-02 11111.     11111.
   3     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

INTERFACE ELEVATION
   1     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.    -85.460     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

MAP OF EXTENT OF INTRUSION (F-FRESHWATER, M-FRESH AND SALTWATER, S-SALTWATER)

   1     . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
   2     . F F F F F F F F F F F F F F F F F F F F F M S S S S S . .
   3     . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

AQUIFER   3
-----------
    MASS BALANCE:
                                        FRESHWATER                         SALTWATER
                                   T.S. RATE  CUM. VOLUME          T.S. RATE   CUM. VOLUME
        CHANGE IN STORAGE         -0.1182E-10 0.1312E+05           0.1182E-10-0.1312E+05
         SOURCES
           RECHARGE                0.0000     0.0000
           CONSTANT HEAD NODES     0.1610E-01 0.1128E+08            0.0000     0.0000
           INJECTION               0.0000     0.0000                0.0000     0.0000
           FW LEAKAGE ACROSS TOP   0.1400E-02 0.9621E+06            0.0000     0.0000
           FW LEAKAGE ACROSS BOT   0.1649E-01 0.1164E+08            0.6534E-02 0.4078E+07
           SW LEAKAGE ACROSS TOP   0.0000     0.0000                0.1179E-16 0.8272E-08
           SW LEAKAGE ACROSS BOT   0.0000     0.0000                0.4046E-04 0.3408E+06
           TOTAL                   0.3400E-01 0.2388E+08            0.6575E-02 0.4418E+07
         SINKS
           CONSTANT HEAD NODES     0.9684E-03 0.6797E+06            0.2458E-04 0.3488E+05
           PUMPAGE                 0.0000     0.0000                0.0000     0.0000
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          LEAKAGE ACROSS TOP    0.3303E-01 0.2319E+08            0.6529E-02 0.4386E+07
          LEAKAGE ACROSS BOT    0.0000     0.0000                0.2095E-04 0.1093E+05
          TOTAL                 0.3400E-01 0.2387E+08            0.6575E-02 0.4432E+07
        SOURCES-SINKS           0.7211E-08 0.1312E+05            0.4161E-07-0.1311E+05
      RELATIVE ERROR (%)
          INFLUX               -0.2124E-04 0.5183E-05           -0.6327E-03-0.1882E-03
          STORAGE               0.6108E+05 0.9435E-02           -0.3518E+06 0.6338E-01

FRESHWATER HEADS
  1    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
  2    11111.     9.9400     9.2353     8.3519     7.2456     6.2098     5.3678     4.6950     4.1456     3.7272
       3.3312     2.8496     2.4054     2.0119     1.6839     1.4419     1.2237     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
  3    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

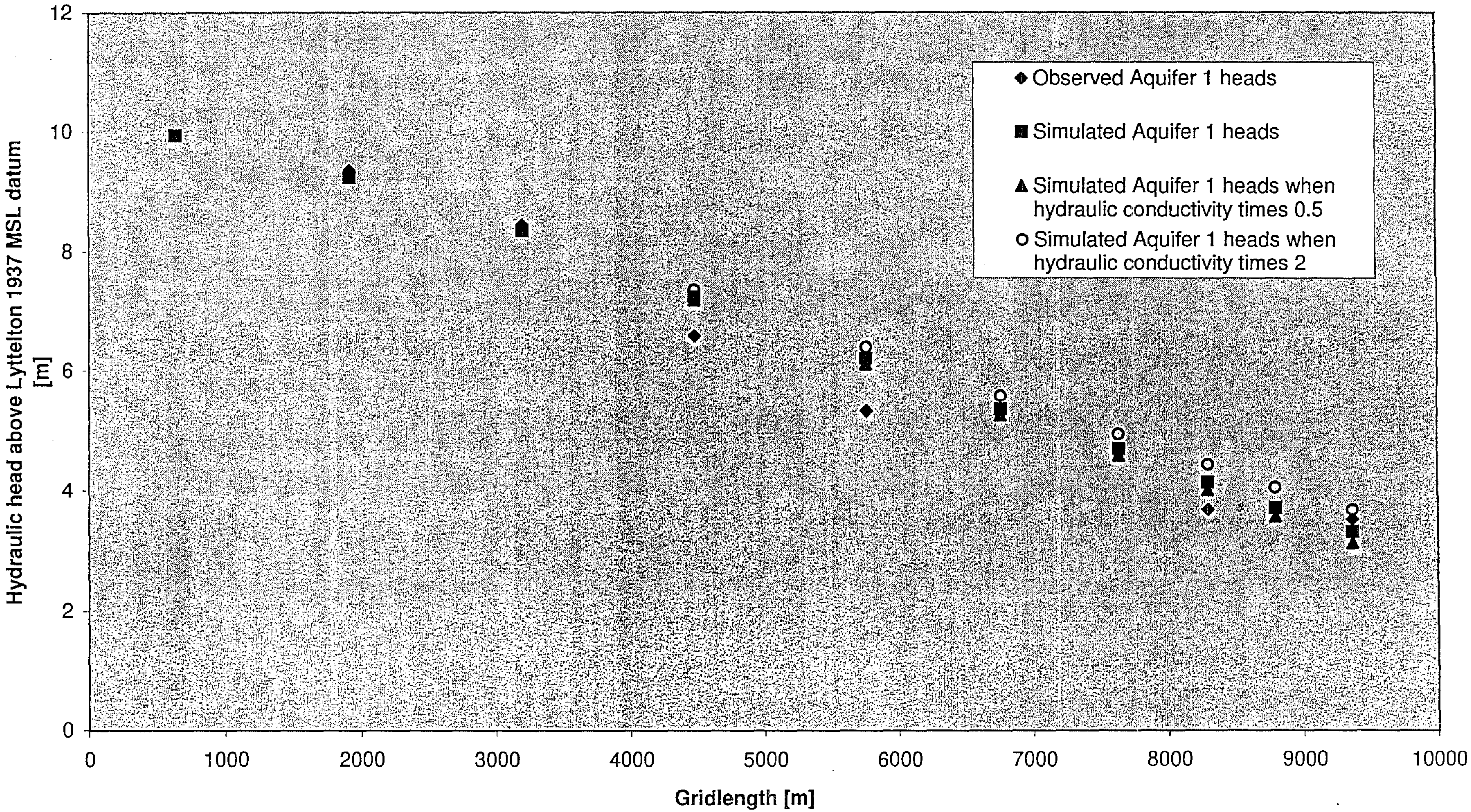
SALTWATER HEADS
  1    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
  2    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.    0.22732    0.22732    0.22720    0.21242    0.18867
      0.16049    0.12920    0.87281E-010.28257E-010.85039E-020.24342E-020.00000    0.31793E-030.38840E-09 11111.
  3    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

INTERFACE ELEVATION
  1    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
  2    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.    -48.355    -39.628     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
  3    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
       11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

MAP OF EXTENT OF INTRUSION (F-FRESHWATER, M-FRESH AND SALTWATER, S-SALTWATER)

  1    . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
  2    . F F F F F F F F F F F F F F M M S S S S S S S S S S S S .
  3    . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
```

Appendix D.6 Sensitivity analysis for hydraulic conductivity



Sensitivity analysis for hydraulic conductivity

```
*************************
STEADY STATE ACHIEVED AT:
*************************

.............
TIME STEP  14
.............
                          SECONDS      HOURS       DAYS        YEARS
  TIME STEP SIZE:         0.1662E+09 0.4616E+05  1923.         5.266
  PUMPING PERIOD TIME:    0.7018E+09 0.1949E+06  8123.         22.24
  TOTAL SIMULATION TIME:  0.7018E+09 0.1949E+06  8123.         22.24

MAXIMUM FRESHWATER HEAD CHANGE: 0.3581E-04
MAXIMUM SALTWATER HEAD CHANGE:  0.2139E-04

.............................
AQUIFER PARAMETERS FOR LAYER  3
.............................

HYDRAULIC CONDUCTIVITY OF FRESHWATER IN X-DIRECTION
   1    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
   2    0.0000     0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02
        0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02
        0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.1500E-02 0.0000
   3    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000


AQUIFER   3
-----------
     MASS BALANCE:
                                           FRESHWATER                         SALTWATER
                                     T.S. RATE   CUM. VOLUME           T.S. RATE   CUM. VOLUME
         CHANGE IN STORAGE          -0.1182E-10 0.1312E+05            0.1182E-10-0.1312E+05
           SOURCES
             RECHARGE                 0.0000     0.0000
             CONSTANT HEAD NODES      0.1610E-01 0.1128E+08             0.0000     0.0000
             INJECTION                0.0000     0.0000                 0.0000     0.0000
             FW LEAKAGE ACROSS TOP    0.1400E-02 0.9621E+06             0.0000     0.0000
             FW LEAKAGE ACROSS BOT    0.1649E-01 0.1164E+08             0.6534E-02 0.4078E+07
             SW LEAKAGE ACROSS TOP    0.0000     0.0000                 0.1179E-16 0.8272E-08
             SW LEAKAGE ACROSS BOT    0.0000     0.0000                 0.4046E-04 0.3408E+06
             TOTAL                    0.3400E-01 0.2388E+08             0.6575E-02 0.4418E+07
           SINKS
             CONSTANT HEAD NODES      0.9684E-03 0.6797E+06             0.2458E-04 0.3488E+05
             PUMPAGE                  0.0000     0.0000                 0.0000     0.0000
             LEAKAGE ACROSS TOP       0.3303E-01 0.2319E+08             0.6529E-02 0.4386E+07
             LEAKAGE ACROSS BOT       0.0000     0.0000                 0.2095E-04 0.1093E+05
             TOTAL                    0.3400E-01 0.2387E+08             0.6575E-02 0.4432E+07
           SOURCES-SINKS              0.7211E-08 0.1312E+05             0.4161E-07-0.1311E+05
         RELATIVE ERROR (%)
             INFLUX                  -0.2124E-04 0.5183E-05            -0.6327E-03-0.1882E-03
             STORAGE                  0.6108E+05 0.9435E-02            -0.3518E+06 0.6338E-01

FRESHWATER HEADS
   1    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2    11111.     9.9400     9.2353     8.3519     7.2456     6.2098     5.3678     4.6950     4.1456     3.7272
        3.3312     2.8496     2.4054     2.0119     1.6839     1.4419     1.2237     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

SALTWATER HEADS
   1    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     0.22732    0.22732    0.22720    0.21242    0.18867
       0.16049    0.12920    0.87281E-010.28257E-010.85039E-020.24342E-020.00000    0.31793E-030.38840E-09 11111.
   3    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

INTERFACE ELEVATION
   1    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     -48.355    -39.628    11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

MAP OF EXTENT OF INTRUSION (F-FRESHWATER, M-FRESH AND SALTWATER, S-SALTWATER

   1    . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
   2    . F F F F F F F F F F F F F F M M S S S S S S S S S S S S .
   3    . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
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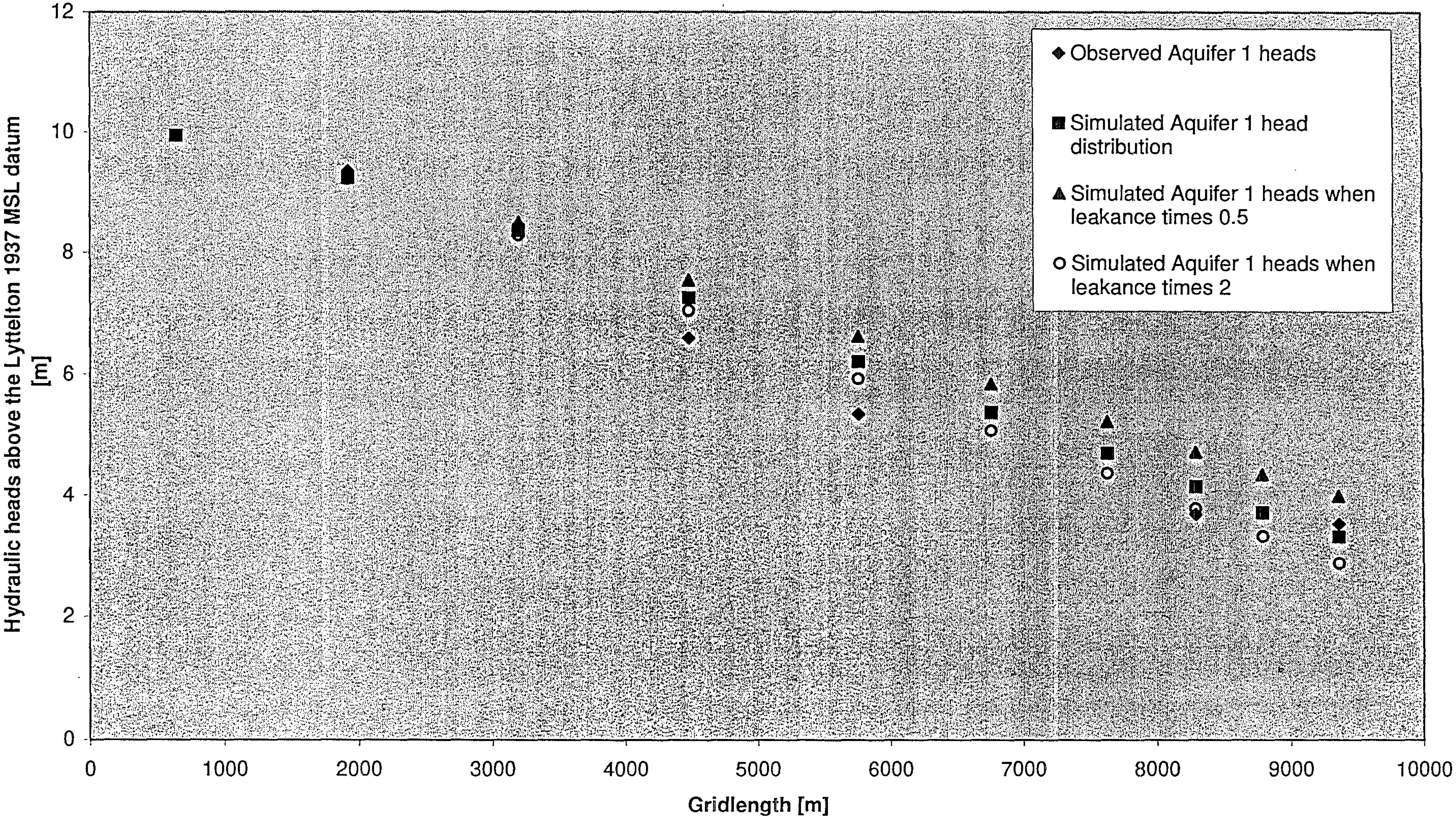
```
Mean hydraulic conductivity times 0.5
*************************
STEADY STATE ACHIEVED AT:
*************************

-------------
TIME STEP  35
-------------
                          SECONDS     HOURS      DAYS      YEARS
  TIME STEP SIZE:        0.4113E+11 0.1143E+08 0.4760E+06  1303.
  PUMPING PERIOD TIME:   0.1782E+12 0.4950E+08 0.2063E+07  5647.
  TOTAL SIMULATION TIME: 0.1782E+12 0.4950E+08 0.2063E+07  5647.

MAXIMUM FRESHWATER HEAD CHANGE: 0.3477E-04
MAXIMUM SALTWATER HEAD CHANGE:  0.2285E-05

------------------------------
AQUIFER PARAMETERS FOR LAYER  3
------------------------------

HYDRAULIC CONDUCTIVITY OF FRESHWATER IN X-DIRECTION
   1    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
   2    0.0000     0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03
        0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03
        0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.7500E-03 0.0000
   3    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

AQUIFER   3
-----------
    MASS BALANCE:
                                        FRESHWATER                          SALTWATER
                                  T.S. RATE   CUM. VOLUME           T.S. RATE   CUM. VOLUME
        CHANGE IN STORAGE        -0.3425E-11  6780.                 0.3425E-11 -6780.
         SOURCES
           RECHARGE               0.0000      0.0000
           CONSTANT HEAD NODES    0.7559E-02 0.1351E+10             0.0000      0.0000
           INJECTION              0.0000      0.0000                0.0000      0.0000
           FW LEAKAGE ACROSS TOP  0.1269E-02 0.2408E+09             0.0000      0.0000
           FW LEAKAGE ACROSS BOT  0.1514E-01 0.2622E+10             0.7511E-02 0.1087E+10
           SW LEAKAGE ACROSS TOP  0.0000      0.0000                0.1179E-16 0.2101E-05
           SW LEAKAGE ACROSS BOT  0.0000      0.0000                0.2263E-03 0.2111E+10
           TOTAL                  0.2397E-01 0.4213E+10             0.7738E-02 0.3198E+10
         SINKS
           CONSTANT HEAD NODES    0.9684E-03 0.1726E+09             0.2368E-04 0.1941E+09
           PUMPAGE                0.0000      0.0000                0.0000      0.0000
           LEAKAGE ACROSS TOP     0.2300E-01 0.4041E+10             0.7714E-02 0.3004E+10
           LEAKAGE ACROSS BOT     0.0000      0.0000                0.0000       5673.
           TOTAL                  0.2397E-01 0.4213E+10             0.7738E-02 0.3198E+10
         SOURCES-SINKS           -0.4360E-07 0.7634E+05            -0.4996E-08 -9425.
        RELATIVE ERROR (%)
           INFLUX                 0.1819E-03-0.1651E-02             0.6461E-04 0.8267E-04
           STORAGE               -0.1273E+07 -1026.                 0.1459E+06 -39.00

FRESHWATER HEADS
   1    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2    11111.     9.9400     9.2784     8.3837     7.1919     6.1134     5.2743     4.5970     4.0284     3.5824
        3.1408     2.5640     2.0870     1.7210     1.4647     1.2172     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

SALTWATER HEADS
   1    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     0.36326    0.36326    0.36326    0.34710    0.31073    0.27267    0.22800
       0.14836    0.48796E-010.16391E-010.65649E-020.32976E-020.17544E-020.00000    0.65944E-030.40279E-09 11111.
   3    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

INTERFACE ELEVATION
   1    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     -43.694    11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

MAP OF EXTENT OF INTRUSION (F-FRESHWATER, M-FRESH AND SALTWATER, S-SALTWATER)

   1    . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
   2    . F F F F F F F F F F F F F M S S S S S S S S S S S S S S .
   3    . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
```

```
Mean hydraulic conductivity times 2
*************************
STEADY STATE ACHIEVED AT:
*************************

-------------
TIME STEP   9
-------------
                              SECONDS      HOURS      DAYS        YEARS
  TIME STEP SIZE:           0.4470E+08 0.1242E+05  517.4         1.417
  PUMPING PERIOD TIME:      0.1754E+09 0.4873E+05  2031.         5.559
  TOTAL SIMULATION TIME:    0.1754E+09 0.4873E+05  2031.         5.559

MAXIMUM FRESHWATER HEAD CHANGE: 0.1498E-04
MAXIMUM SALTWATER HEAD CHANGE:  0.1740E-04

------------------------------
AQUIFER PARAMETERS FOR LAYER  3
------------------------------

HYDRAULIC CONDUCTIVITY OF FRESHWATER IN X-DIRECTION
   1    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
   2    0.0000     0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02
        0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02
        0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.3000E-02 0.0000
   3    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000


AQUIFER    3
-----------
     MASS BALANCE:
                                          FRESHWATER                        SALTWATER
                                    T.S. RATE   CUM. VOLUME          T.S. RATE   CUM. VOLUME
         CHANGE IN STORAGE          0.1912E-09 0.1371E+05            -0.1912E-09-0.1371E+05
          SOURCES
            RECHARGE                 0.0000     0.0000
            CONSTANT HEAD NODES      0.3244E-01 0.5700E+07             0.0000     0.0000
            INJECTION                0.0000     0.0000                 0.0000     0.0000
            FW LEAKAGE ACROSS TOP    0.9977E-03 0.1949E+06             0.0000     0.0000
            FW LEAKAGE ACROSS BOT    0.1919E-01 0.3280E+07             0.0000     0.0000
            SW LEAKAGE ACROSS TOP    0.0000     0.0000                 0.1179E-16 0.2068E-08
            SW LEAKAGE ACROSS BOT    0.0000     0.0000                 0.3222E-02 0.6116E+06
            TOTAL                    0.5263E-01 0.9174E+07             0.3222E-02 0.6116E+06
          SINKS
            CONSTANT HEAD NODES      0.9684E-03 0.1699E+06             0.1775E-03 0.3515E+05
            PUMPAGE                  0.0000     0.0000                 0.0000     0.0000
            LEAKAGE ACROSS TOP       0.5166E-01 0.8741E+07             0.3044E-02 0.5901E+06
            LEAKAGE ACROSS BOT       0.0000     0.0000                 0.0000     0.0000
            TOTAL                    0.5263E-01 0.8911E+07             0.3222E-02 0.6253E+06
          SOURCES-SINKS              0.1176E-07 0.2632E+06             0.1888E-07-0.1371E+05
        RELATIVE ERROR (%)
            INFLUX                  -0.2198E-04 -2.719                -0.5921E-03-0.7779E-03
            STORAGE                 -6049.      -1819.                  9975.     0.3469E-01

FRESHWATER HEADS
   1    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2    11111.     9.9400     9.2302     8.3832     7.3674     6.4004     5.5962     4.9584     4.4462     4.0631
        3.7094     3.2968     2.8880     2.4938     2.1261     1.8011     1.5285     1.3183     1.1172     0.88234
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

SALTWATER HEADS
   1    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     0.11205    0.11205    0.10594
       0.93861E-010.77475E-010.56855E-010.33990E-010.18648E-010.87320E-020.00000    0.15685E-020.38319E-08 11111.
   3    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

INTERFACE ELEVATION
   1    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.    -48.139    -40.095     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

MAP OF EXTENT OF INTRUSION (F-FRESHWATER, M-FRESH AND SALTWATER, S-SALTWATER)

   1    . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
   2    . F F F F F F F F F F F F F F F F M M S S S S S S S S S S .
   3    . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
```

Appendix D.7 Sensitivity analysis for leakance



Sensitivity analysis for aquitard leakance

```
 *************************
 STEADY STATE ACHIEVED AT:
 *************************

 -------------
 TIME STEP  14
 -------------
                            SECONDS       HOURS       DAYS        YEARS
   TIME STEP SIZE:         0.1662E+09 0.4616E+05  1923.         5.266
   PUMPING PERIOD TIME:    0.7018E+09 0.1949E+06  8123.         22.24
   TOTAL SIMULATION TIME:  0.7018E+09 0.1949E+06  8123.         22.24

 MAXIMUM FRESHWATER HEAD CHANGE: 0.3581E-04
 MAXIMUM SALTWATER HEAD CHANGE:  0.2139E-04

 ------------------------------
 AQUIFER PARAMETERS FOR LAYER  3
 ------------------------------

 AQUITARD LEAKANCES (K"/B")
    1     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
    2     0.0000     0.4500E-08 0.4500E-08 0.3600E-08 0.2970E-08 0.2610E-08 0.2610E-08 0.2250E-08 0.2250E-08 0.2250E-08
          0.2250E-08 0.2340E-08 0.2340E-08 0.2430E-08 0.2610E-08 0.2610E-08 0.2610E-08 0.2970E-08 0.2970E-08 0.2970E-08
          0.2970E-08 0.2970E-08 0.2970E-08 0.2970E-08 0.2970E-08 0.2970E-08 0.2970E-08 0.2970E-08 0.9000E-03 0.0000
    3     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

 AQUIFER   3
 -----------
      MASS BALANCE:
                                          FRESHWATER                        SALTWATER
                                     T.S. RATE   CUM. VOLUME           T.S. RATE   CUM. VOLUME
          CHANGE IN STORAGE         -0.1182E-10 0.1312E+05             0.1182E-10-0.1312E+05
           SOURCES
             RECHARGE                0.0000     0.0000
             CONSTANT HEAD NODES     0.1610E-01 0.1128E+08              0.0000     0.0000
             INJECTION               0.0000     0.0000                  0.0000     0.0000
             FW LEAKAGE ACROSS TOP   0.1400E-02 0.9621E+06              0.0000     0.0000
             FW LEAKAGE ACROSS BOT   0.1649E-01 0.1164E+08              0.6534E-02 0.4078E+07
             SW LEAKAGE ACROSS TOP   0.0000     0.0000                  0.1179E-16 0.8272E-08
             SW LEAKAGE ACROSS BOT   0.0000     0.0000                  0.4046E-04 0.3408E+06
             TOTAL                   0.3400E-01 0.2388E+08              0.6575E-02 0.4418E+07
           SINKS
             CONSTANT HEAD NODES     0.9684E-03 0.6797E+06              0.2458E-04 0.3488E+05
             PUMPAGE                 0.0000     0.0000                  0.0000     0.0000
             LEAKAGE ACROSS TOP      0.3303E-01 0.2319E+08              0.6529E-02 0.4386E+07
             LEAKAGE ACROSS BOT      0.0000     0.0000                  0.2095E-04 0.1093E+05
             TOTAL                   0.3400E-01 0.2387E+08              0.6575E-02 0.4432E+07
           SOURCES-SINKS             0.7211E-08 0.1312E+05              0.4161E-07-0.1311E+05
         RELATIVE ERROR (%)
             INFLUX                 -0.2124E-04 0.5183E-05             -0.6327E-03-0.1882E-03
             STORAGE                 0.6108E+05 0.9435E-02             -0.3518E+06 0.6338E-01

 FRESHWATER HEADS
    1     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
    2     11111.     9.9400     9.2353     8.3519     7.2456     6.2098     5.3678     4.6950     4.1456     3.7272
          3.3312     2.8496     2.4054     2.0119     1.6839     1.4419     1.2237     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
    3     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

 SALTWATER HEADS
    1     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
    2     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.     0.22732    0.22732    0.22720    0.21242    0.18867
         0.16049    0.12920    0.87281E-010.28257E-010.85039E-020.24342E-020.00000    0.31793E-030.38840E-09 11111.
    3     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

 INTERFACE ELEVATION
    1     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
    2     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.    -48.355    -39.628     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
    3     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
          11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

 MAP OF EXTENT OF INTRUSION (F-FRESHWATER, M-FRESH AND SALTWATER, S-SALTWATER)

    1     . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
    2     . F F F F F F F F F F F F F F F F M M S S S S S S S S S S S .
    3     . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
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Leakance times 0.5
*************************
STEADY STATE ACHIEVED AT:
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-------------
TIME STEP  14
-------------
                             SECONDS     HOURS       DAYS       YEARS
  TIME STEP SIZE:          0.1662E+09 0.4616E+05  1923.       5.266
  PUMPING PERIOD TIME:     0.7018E+09 0.1949E+06  8123.       22.24
  TOTAL SIMULATION TIME: 0.7018E+09 0.1949E+06  8123.       22.24

MAXIMUM FRESHWATER HEAD CHANGE: 0.3581E-04
MAXIMUM SALTWATER HEAD CHANGE:  0.2139E-04

------------------------------
AQUIFER PARAMETERS FOR LAYER  3
------------------------------

AQUITARD LEAKANCES (K"/B")
   1     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
   2     0.0000     0.2250E-08 0.2250E-08 0.1800E-08 0.1485E-08 0.1305E-08 0.1305E-08 0.1125E-08 0.1125E-08 0.1125E-08
         0.1125E-08 0.1170E-08 0.1170E-08 0.1215E-08 0.1305E-08 0.1305E-08 0.1305E-08 0.1485E-08 0.1485E-08 0.1485E-08
         0.1485E-08 0.1485E-08 0.1485E-08 0.1485E-08 0.1485E-08 0.1485E-08 0.1485E-08 0.1485E-08 0.4500E-03 0.0000
   3     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000

AQUIFER   3
-----------
    MASS BALANCE:
                                          FRESHWATER                          SALTWATER
                                     T.S. RATE   CUM. VOLUME          T.S. RATE   CUM. VOLUME
        CHANGE IN STORAGE            0.2243E-09 0.2745E+05           -0.2243E-09-0.2745E+05
         SOURCES
           RECHARGE                   0.0000     0.0000
           CONSTANT HEAD NODES        0.1466E-01 0.5903E+07            0.0000     0.0000
           INJECTION                  0.0000     0.0000                0.0000     0.0000
           FW LEAKAGE ACROSS TOP      0.1480E-03 0.5143E+05            0.0000     0.0000
           FW LEAKAGE ACROSS BOT      0.1956E-01 0.7591E+07            0.3766E-04 0.2186E+05
           SW LEAKAGE ACROSS TOP      0.0000     0.0000                0.5893E-17 0.2403E-08
           SW LEAKAGE ACROSS BOT      0.0000     0.0000                0.2385E-02 0.1145E+07
           TOTAL                      0.3436E-01 0.1355E+08            0.2423E-02 0.1167E+07
         SINKS
           CONSTANT HEAD NODES        0.9684E-03 0.3949E+06            0.1890E-03 0.8978E+05
           PUMPAGE                    0.0000     0.0000                0.0000     0.0000
           LEAKAGE ACROSS TOP         0.3339E-01 0.1312E+08            0.2234E-02 0.1104E+07
           LEAKAGE ACROSS BOT         0.0000     0.0000                0.0000     0.0000
           TOTAL                      0.3436E-01 0.1352E+08            0.2423E-02 0.1194E+07
         SOURCES-SINKS                0.3637E-07 0.2745E+05           -0.2047E-07-0.2746E+05
        RELATIVE ERROR (%)
           INFLUX                    -0.1052E-03 0.6417E-05            0.8357E-03 0.1276E-02
           STORAGE                   -0.1612E+05 0.3167E-02           -9027.      -0.5422E-01

FRESHWATER HEADS
   1     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2     11111.     9.9400     9.2986     8.5123     7.5527     6.6301     5.8561     5.2386     4.7390     4.3631
         4.0146     3.6058     3.1985     2.8021     2.4269     2.0877     1.7914     1.5435     1.3598     1.2498
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

SALTWATER HEADS
   1     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     0.16790
        0.15442    0.13169    0.98565E-010.60273E-010.34246E-010.16771E-010.00000     0.35399E-020.86486E-08 11111.
   3     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

INTERFACE ELEVATION
   1     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     -43.108
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

MAP OF EXTENT OF INTRUSION (F-FRESHWATER, M-FRESH AND SALTWATER, S-SALTWATER)

   1     . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
   2     . F F F F F F F F F F F F F F F F F F M S S S S S S S S S .
   3     . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
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Leakance times 2
************************
STEADY STATE ACHIEVED AT:
************************

-------------
TIME STEP  12
-------------
                            SECONDS      HOURS      DAYS      YEARS
  TIME STEP SIZE:         0.8041E+08 0.2234E+05  930.6       2.548
  PUMPING PERIOD TIME:    0.3335E+09 0.9263E+05  3860.       10.57
  TOTAL SIMULATION TIME:  0.3335E+09 0.9263E+05  3860.       10.57

MAXIMUM FRESHWATER HEAD CHANGE: 0.7782E-05
MAXIMUM SALTWATER HEAD CHANGE:  0.3735E-04


AQUITARD LEAKANCES (K"/B")
   1    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
   2    0.0000     0.9000E-08 0.9000E-08 0.7200E-08 0.5940E-08 0.5220E-08 0.5220E-08 0.4500E-08 0.4500E-08 0.4500E-08
        0.4500E-08 0.4680E-08 0.4680E-08 0.4860E-08 0.5220E-08 0.5220E-08 0.5220E-08 0.5940E-08 0.5940E-08 0.5940E-08
        0.5940E-08 0.5940E-08 0.5940E-08 0.5940E-08 0.5940E-08 0.5940E-08 0.5940E-08 0.5940E-08 0.1800E-02 0.0000
   3    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
AQUIFER   3
-----------
     MASS BALANCE:
                                         FRESHWATER                           SALTWATER
                                   T.S. RATE   CUM. VOLUME              T.S. RATE   CUM. VOLUME
         CHANGE IN STORAGE         0.5825E-11 0.1303E+05               -0.5825E-11-0.1303E+05
          SOURCES
            RECHARGE                0.0000     0.0000
            CONSTANT HEAD NODES     0.1641E-01 0.5471E+07                0.0000     0.0000
            INJECTION               0.0000     0.0000                    0.0000     0.0000
            FW LEAKAGE ACROSS TOP   0.5244E-02 0.1744E+07                0.0000     0.0000
            FW LEAKAGE ACROSS BOT   0.1599E-01 0.5306E+07                0.1076E-02 0.3450E+06
            SW LEAKAGE ACROSS TOP   0.0000     0.0000                    0.2357E-16 0.7861E-08
            SW LEAKAGE ACROSS BOT   0.0000     0.0000                    0.6061E-02 0.2002E+07
            TOTAL                   0.3764E-01 0.1252E+08                0.7137E-02 0.2347E+07
          SINKS
            CONSTANT HEAD NODES     0.9684E-03 0.3230E+06                0.1070E-03 0.3840E+05
            PUMPAGE                 0.0000     0.0000                    0.0000     0.0000
            LEAKAGE ACROSS TOP      0.3668E-01 0.1218E+08                0.7030E-02 0.2322E+07
            LEAKAGE ACROSS BOT      0.0000      1106.                    0.0000     0.0000
            TOTAL                   0.3764E-01 0.1251E+08                0.7137E-02 0.2360E+07
          SOURCES-SINKS             0.9149E-09 0.1304E+05                0.1255E-07-0.1303E+05
         RELATIVE ERROR (%)
            INFLUX                 -0.2415E-05-0.1892E-04               -0.1759E-03-0.1221E-03
            STORAGE                -0.1561E+05-0.1817E-01                0.2155E+06 0.2200E-01

FRESHWATER HEADS
   1    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2    11111.     9.9400     9.2219     8.2831     7.0496     5.9383     5.0774     4.3830     3.8035     3.3508
        2.9042     2.3238     1.8464     1.4865     1.2326    0.99577     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

SALTWATER HEADS
   1    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.    0.15360    0.15360    0.15360    0.12891    0.10569    0.86451E-010.69430E-01
       0.54226E-010.41014E-010.30025E-010.21168E-010.13160E-010.51237E-020.00000    0.14116E-020.86236E-09 11111.
   3    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

INTERFACE ELEVATION
   1    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.    -43.007     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3    11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
        11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

MAP OF EXTENT OF INTRUSION (F-FRESHWATER, M-FRESH AND SALTWATER, S-SALTWATER)

   1    . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
   2    . F F F F F F F F F F F F F M S S S S S S S S S S S S S S .
   3    . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
```
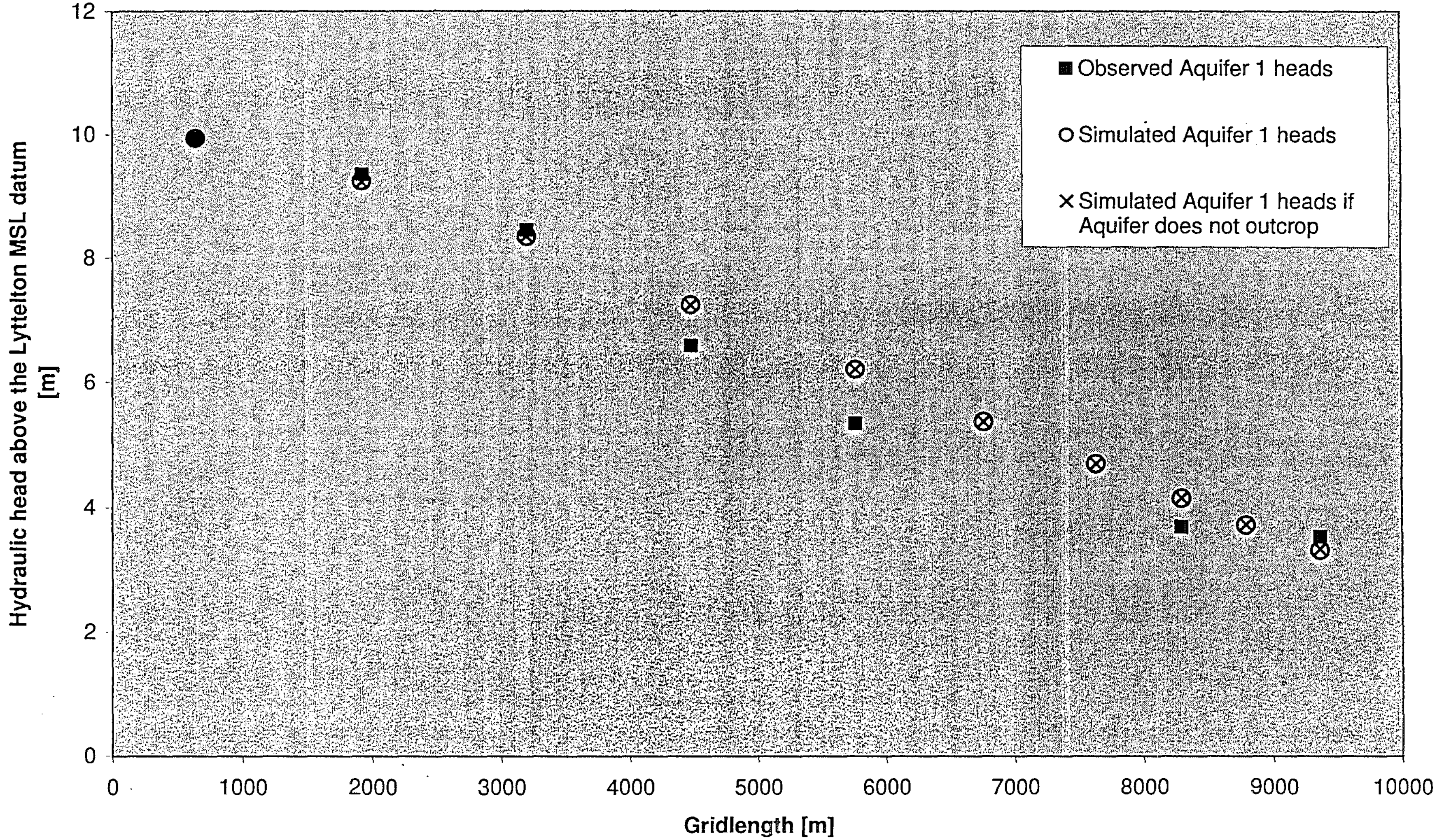

Appendix D.8 Sensitivity analysis on whether Aquifer 1 outcrops or not



```
Sensitivity analysis for whether Aquifer 1  outcrops or not
Aquifer 1 outcrops
 ************************
 STEADY STATE ACHIEVED AT:
 ************************

 -------------
 TIME STEP  14
 -------------
                              SECONDS      HOURS       DAYS        YEARS
   TIME STEP SIZE:          0.1662E+09 0.4616E+05  1923.        5.266
   PUMPING PERIOD TIME:     0.7018E+09 0.1949E+06  8123.        22.24
   TOTAL SIMULATION TIME:   0.7018E+09 0.1949E+06  8123.        22.24

MAXIMUM FRESHWATER HEAD CHANGE: 0.3581E-04
MAXIMUM SALTWATER HEAD CHANGE:  0.2139E-04
-----------------------------
AQUIFER PARAMETERS FOR LAYER  3
-----------------------------
   0  0.90E-07                        AQL
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.050     0.050     0.040     0.033     0.029     0.029     0.025     0.025     0.025
   0.025     0.026     0.026     0.027     0.029     0.029     0.029     0.033     0.033     0.033
   0.033     0.033     0.033     0.033     0.033     0.033     0.033     0.033     10000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
   0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

AQUIFER   3
----------
     MASS BALANCE:
                                          FRESHWATER                          SALTWATER
                                     T.S. RATE    CUM. VOLUME           T.S. RATE    CUM. VOLUME
         CHANGE IN STORAGE          -0.1182E-10 0.1312E+05             0.1182E-10-0.1312E+05
          SOURCES
            RECHARGE                  0.0000      0.0000
            CONSTANT HEAD NODES       0.1610E-01 0.1128E+08             0.0000      0.0000
            INJECTION                 0.0000      0.0000                0.0000      0.0000
            FW LEAKAGE ACROSS TOP     0.1400E-02 0.9621E+06             0.0000      0.0000
            FW LEAKAGE ACROSS BOT     0.1649E-01 0.1164E+08             0.6534E-02 0.4078E+07
            SW LEAKAGE ACROSS TOP     0.0000      0.0000                0.1179E-16 0.8272E-08
            SW LEAKAGE ACROSS BOT     0.0000      0.0000                0.4046E-04 0.3408E+06
            TOTAL                     0.3400E-01 0.2388E+08             0.6575E-02 0.4418E+07
          SINKS
            CONSTANT HEAD NODES       0.9684E-03 0.6797E+06             0.2458E-04 0.3488E+05
            PUMPAGE                   0.0000      0.0000                0.0000      0.0000
            LEAKAGE ACROSS TOP        0.3303E-01 0.2319E+08             0.6529E-02 0.4386E+07
            LEAKAGE ACROSS BOT        0.0000      0.0000                0.2095E-04 0.1093E+05
            TOTAL                     0.3400E-01 0.2387E+08             0.6575E-02 0.4432E+07
          SOURCES-SINKS               0.7211E-08 0.1312E+05             0.4161E-07-0.1311E+05
        RELATIVE ERROR (%)
            INFLUX                   -0.2124E-04 0.5183E-05            -0.6327E-03-0.1882E-03
            STORAGE                   0.6108E+05 0.9435E-02            -0.3518E+06 0.6338E-01

FRESHWATER HEADS
   1     11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
   2     11111.      9.9400      9.2353      8.3519      7.2456      6.2098      5.3678      4.6950      4.1456      3.7272
         3.3312      2.8496      2.4054      2.0119      1.6839      1.4419      1.2237      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
   3     11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.

SALTWATER HEADS
   1     11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
   2     11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.    0.22732     0.22732     0.22720     0.21242     0.18867
       0.16049     0.12920     0.87281E-010.28257E-010.85039E-020.24342E-020.00000     0.31793E-030.38840E-09 11111.
   3     11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.

INTERFACE ELEVATION
   1     11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
   2     11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.     -48.355     -39.628      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
   3     11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.
         11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.      11111.

MAP OF EXTENT OF INTRUSION (F-FRESHWATER, M-FRESH AND SALTWATER, S-SALTWATER)

   1     . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
   2     . F F F F F F F F F F F F F F M M S S S S S S S S S S S S .
   3     . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
```

```
Aquifer 1 does not outcrop
 *************************
 STEADY STATE ACHIEVED AT:
 *************************

 -------------
 TIME STEP  12
 -------------
                            SECONDS        HOURS        DAYS        YEARS
   TIME STEP SIZE:          0.1091E+09 0.3030E+05  1263.         3.457
   PUMPING PERIOD TIME:     0.4524E+09 0.1257E+06  5236.         14.34
   TOTAL SIMULATION TIME: 0.4524E+09 0.1257E+06  5236.         14.34

 MAXIMUM FRESHWATER HEAD CHANGE: 0.9883E-05
 MAXIMUM SALTWATER HEAD CHANGE:  0.1442E-04

 ------------------------------
 AQUIFER PARAMETERS FOR LAYER  3
 ------------------------------
   0  0.90E-07                           AQL
     0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
     0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
     0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
     0.000      0.050      0.050      0.040      0.033      0.029      0.029      0.025      0.025      0.025
     0.025      0.026      0.026      0.027      0.029      0.029      0.029      0.033      0.033      0.033
     0.033      0.033      0.033      0.033      0.033      0.033      0.033      0.033      0.033      0.000
     0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
     0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
     0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000

AQUIFER   3
 -----------
      MASS BALANCE:
                                          FRESHWATER                           SALTWATER
                                      T.S. RATE    CUM. VOLUME            T.S. RATE    CUM. VOLUME
          CHANGE IN STORAGE           0.2819E-11 0.1474E+05              -0.2819E-11-0.1474E+05
           SOURCES
             RECHARGE                  0.0000      0.0000
             CONSTANT HEAD NODES       0.1608E-01 0.7255E+07              0.0000      0.0000
             INJECTION                 0.0000      0.0000                 0.0000      0.0000
             FW LEAKAGE ACROSS TOP     0.1350E-02 0.5956E+06              0.0000      0.0000
             FW LEAKAGE ACROSS BOT     0.1644E-01 0.7485E+07              0.4924E-02 0.2035E+07
             SW LEAKAGE ACROSS TOP     0.0000      0.0000                 0.1179E-16 0.5332E-08
             SW LEAKAGE ACROSS BOT     0.0000      0.0000                 0.1560E-02 0.7427E+06
             TOTAL                     0.3387E-01 0.1534E+08              0.6484E-02 0.2778E+07
           SINKS
             CONSTANT HEAD NODES       0.9684E-03 0.4381E+06              0.1093E-03 0.5219E+05
             PUMPAGE                   0.0000      0.0000                 0.0000      0.0000
             LEAKAGE ACROSS TOP        0.3290E-01 0.1488E+08              0.6374E-02 0.2740E+07
             LEAKAGE ACROSS BOT        0.0000      0.0000                 0.0000       247.8
             TOTAL                     0.3387E-01 0.1532E+08              0.6484E-02 0.2793E+07
           SOURCES-SINKS               0.6250E-08 0.1474E+05              0.1779E-07-0.1474E+05
          RELATIVE ERROR (%)
             INFLUX                   -0.1844E-04 0.7720E-05             -0.2745E-03-0.2047E-03
             STORAGE                  -0.2216E+06 0.8031E-02              0.6313E+06 0.3857E-01

 FRESHWATER HEADS
   1     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2     11111.     9.9400     9.2364     8.3546     7.2504     6.2173     5.3785     4.7091     4.1632     3.7479
         3.3552     2.8781     2.4403     2.0559     1.7421     1.5234     1.4250     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

 SALTWATER HEADS
   1     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     0.23678    0.23678    0.22064    0.19069
        0.14074    0.86170E-010.54935E-010.32516E-010.15843E-010.71737E-020.00000    0.19903E-020.53773E-03 11111.
   3     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

 INTERFACE ELEVATION
   1     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   2     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.    -47.293     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
   3     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.
         11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.     11111.

 MAP OF EXTENT OF INTRUSION (F-FRESHWATER, M-FRESH AND SALTWATER, S-SALTWATER)

   1      . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
   2      . F F F F F F F F F F F F F F F M S S S S S S S S S S S S .
   3      . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .
```

Appendix E.1 Resource consents to install the groundwater level and quality monitoring bore at Humphrey's Drive.

CANTERBURY REGIONAL COUNCIL

CRC980172

RESOURCE CONSENT

Pursuant to Section 105 of the Resource Management Act 1991
The Canterbury Regional Council

GRANTS TO: CANTERBURY REGIONAL COUNCIL

A LAND USE CONSENT to install bore M36/5325 at or about map reference M36:8600-3905 for groundwater quality monitoring and water level observation purposes.

DATE GRANTED 18-AUG-1997 *EXPIRY DATE* 18-AUG-2000

IN CONNECTION WITH THE FOLLOWING PROPERTY:

LOCATION CHARLESWORTH RESERVE, HUMPHREYS ROAD, FERRYMEAD

LEGAL DESCRIPTION LOT 3 DP 10158

SUBJECT TO THE FOLLOWING CONDITIONS:

1) The 150 millimetre diameter bore shall be installed to a depth of approximately 30 metres.

2) A completed bore details form and well log shall be forwarded to the Canterbury Regional Council once drilling is completed.

3) The bore shall be sited as shown on the plan submitted with the application dated 04 August 1997.

4) Measures shall be undertaken to prevent surface waters entering underlying groundwater. (This condition can only normally be achieved by having the top of the casing greater than 100 millimetres above the ground surface and grouting around the top of the casing.)

5) The bore shall be installed within two years of the date of granting this resource consent.

6) Charges, set in accordance with section 36 of the Resource Management Act 1991, shall be paid to the Regional Council for the carrying out of its functions in relation to the administration, monitoring and supervision of resource consents and for the carrying out of its functions under section 35 of the Act.

ISSUED AT CHRISTCHURCH ON 18 AUGUST 1997

JD Talbot

John D Talbot
ACTING CHIEF EXECUTIVE

FILE

M05C-0049
131159
17 SEP 1997
M. Dicker
D. Weeks
I. Hertel

15 September, 1997

Michael Dicker
Groundwater Resources Manager
Canterbury Regional Council
PO Box 345
CHRISTCHURCH

Dear Michael,

BRIGHTON SPIT AND WOOLSTON/HEATHCOTE OBSERVATION BORES

Thank you for your application to drill two observation bores into aquifer 1, on the southern boundary of Te Karoro Karoro Reserve and in the Charlesworth Reserve site on Humphreys Drive.

In general we have no problems with you installing the bores for uses as described in your application letter. However the bore near Humphreys Drive (M3615325) will have to be moved approximately 10 metres to the north to avoid being placed on Stourbridge Street (see cadastral overlay attached). If this position is not viable please contact Chris Freeman to arrange a suitable siting.

As indicated in your letter we would appreciate you restoring the ground around the bores to their original condition after installation. We would also like you to paint the boxes a recessive colour such as rangoon green (Resene colour code: 12 B 29).

This approval is given on the condition that the boxes and any costs involved in their installation and removal are the responsibility of the Canterbury Regional Council. Please contact Chris Freeman immediately before you start the installation.

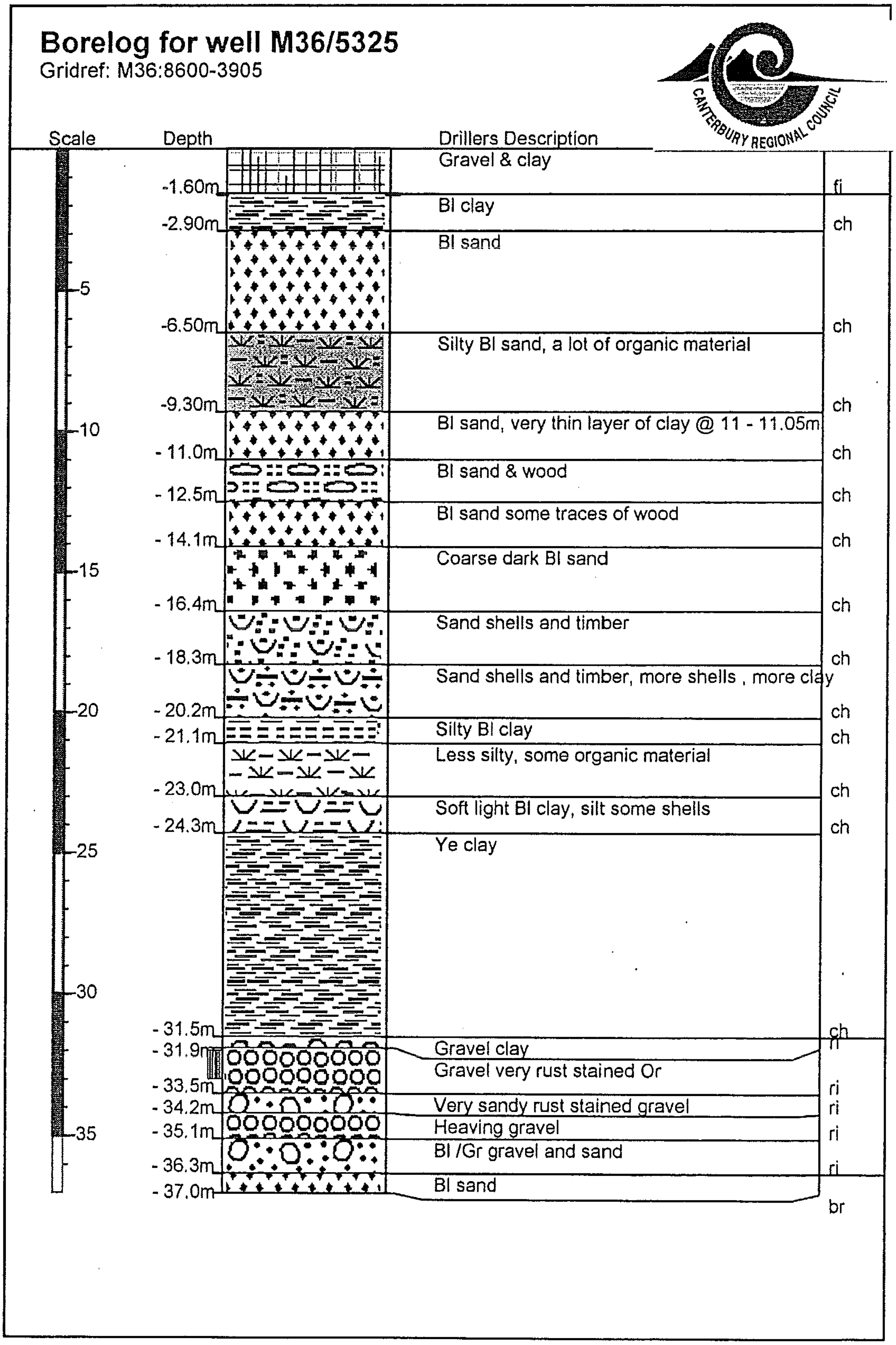
Yours faithfully,

Craig Oliver
PARKS MANAGER

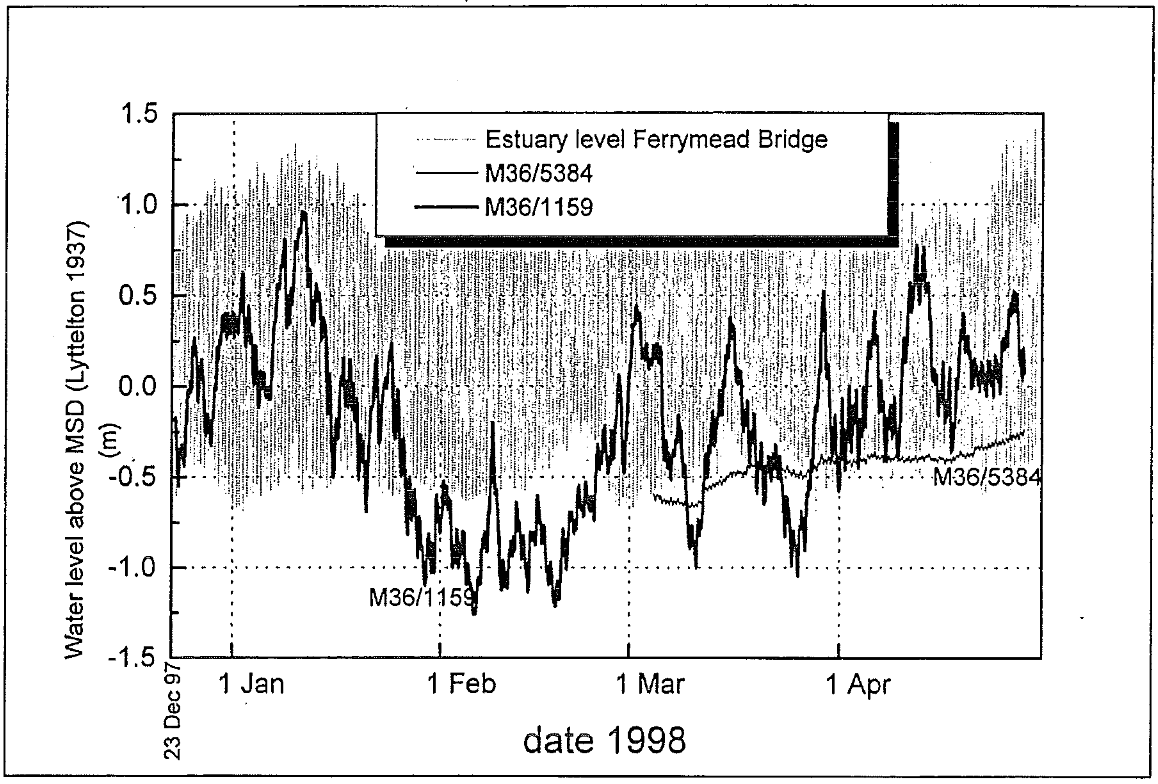
DLA:DLA

Our Ref: **Contact:** Chris Freeman Ph 371-1638 **File Ref:** PK/RT/26

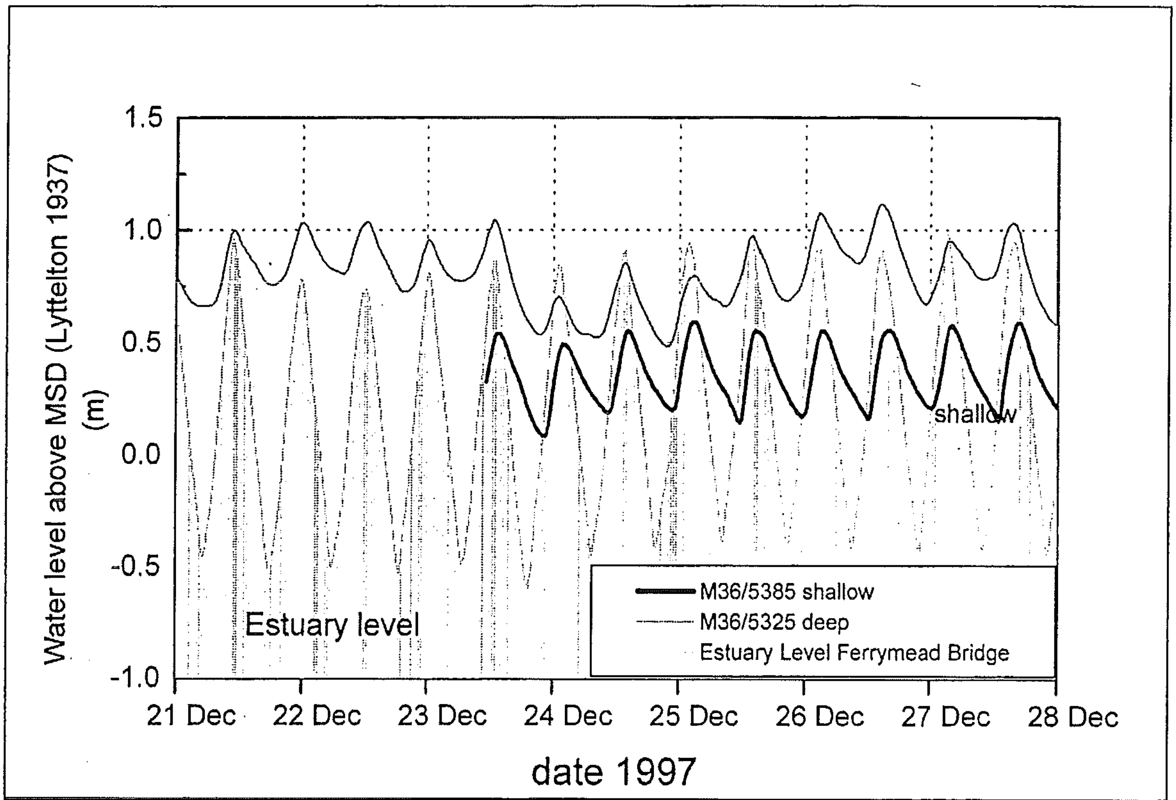
Appendix E.2 Borelog of the installed water level and quality monitoring well at Humphrey's Drive (from CRC database).

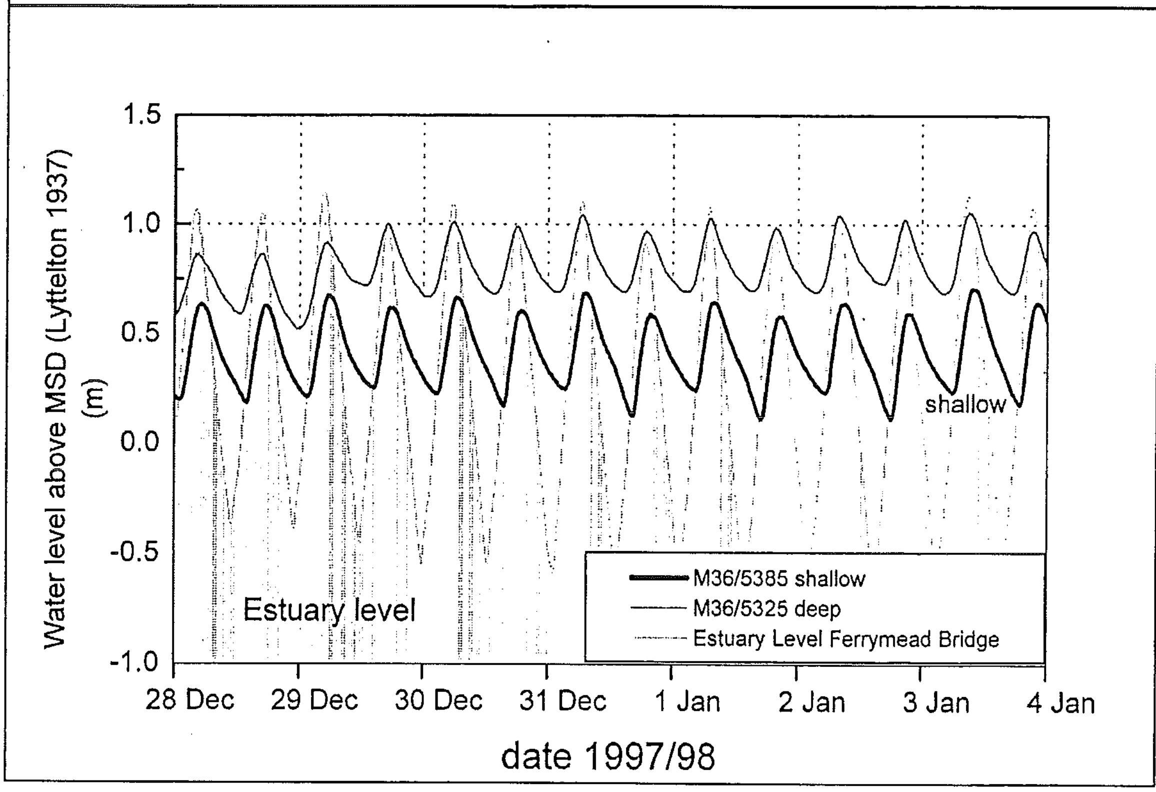


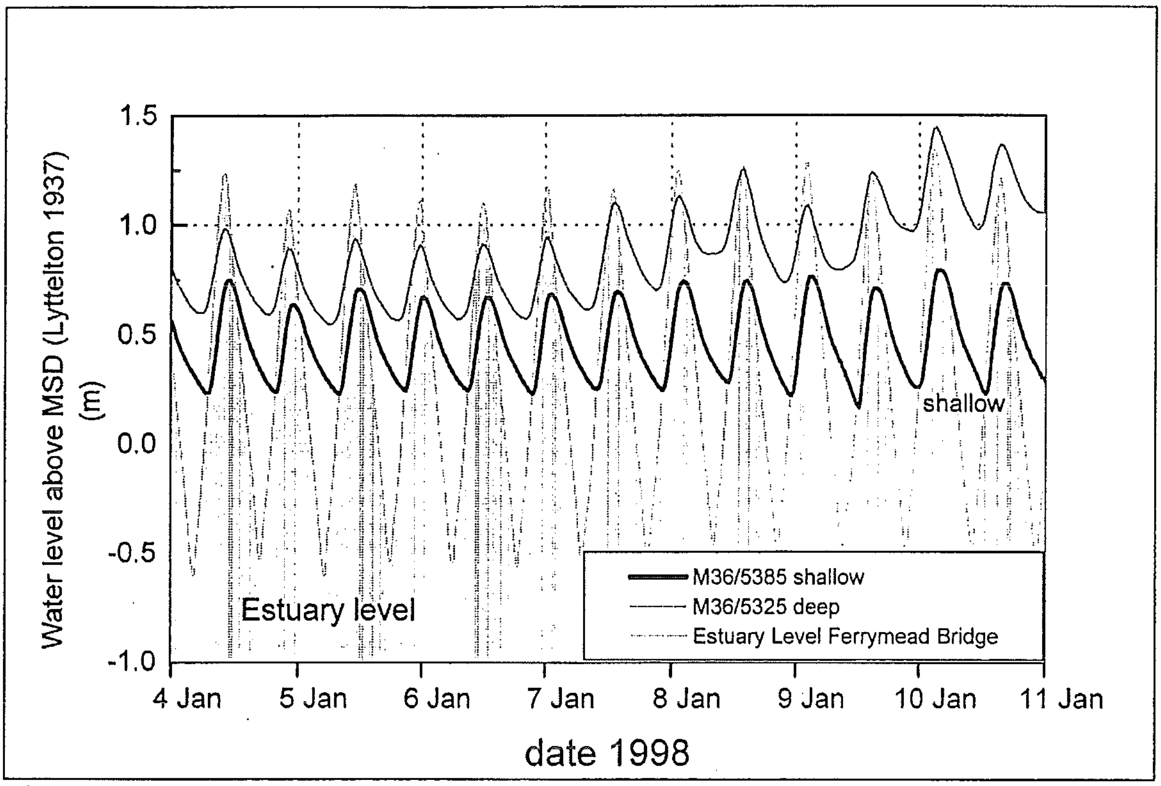
Appendix E.3 Water levels of the shallow piezometer and the Aquifer 1 bore at Scruttons Road, and estuarine water levels from 23 December 1997 to end of April 1998 (prepared by Marc Ettema, 1998).

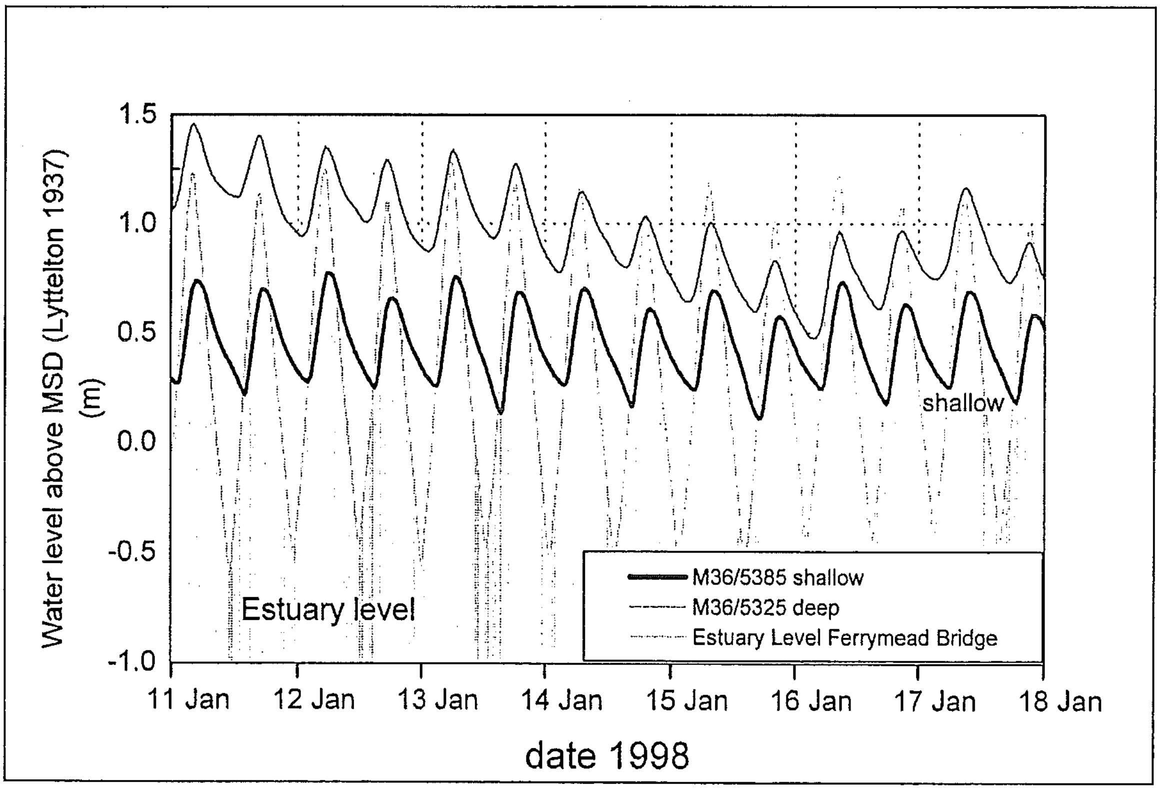


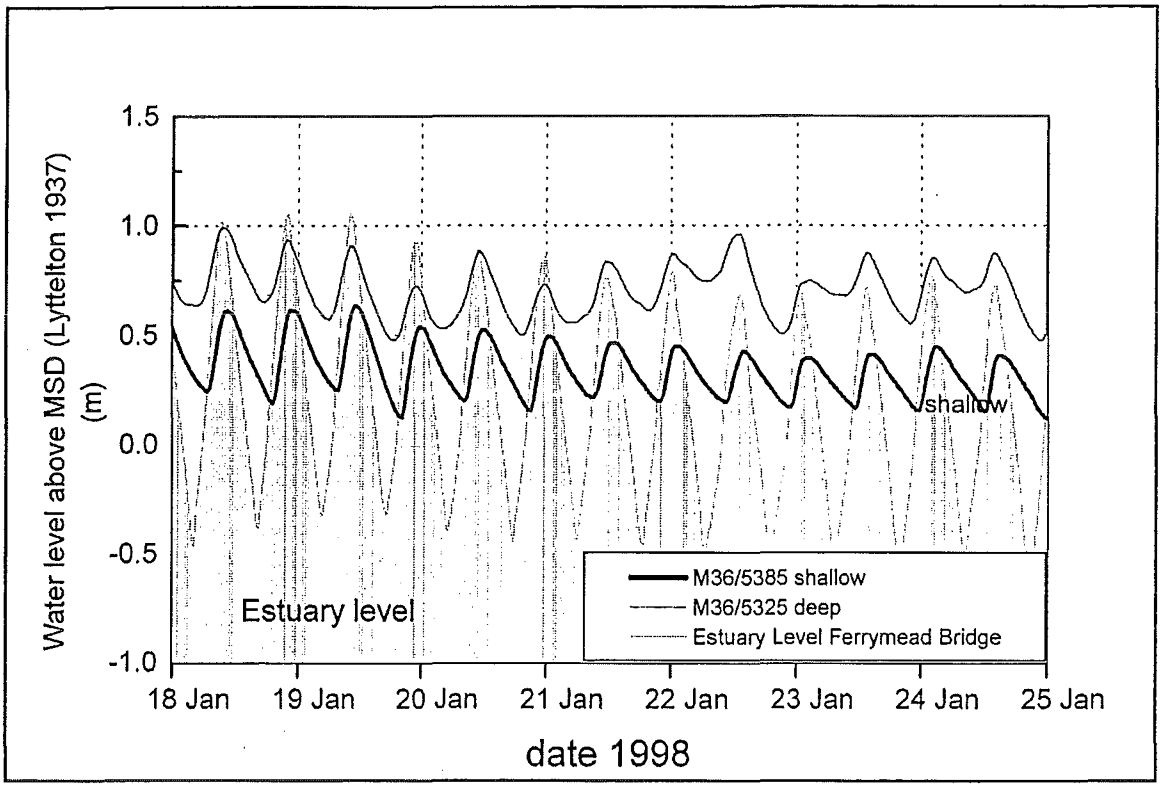
Appendix E.4 Water level data from the shallow and the Aquifer 1 wells at Humphrey's Drive and estuarine water levels from 23 December 1997 to 22 February 1998. The dark grey areas indicate a downward gradient between the uppermost confining layer and Aquifer 1 (prepared by Marc Ettema, 1998).



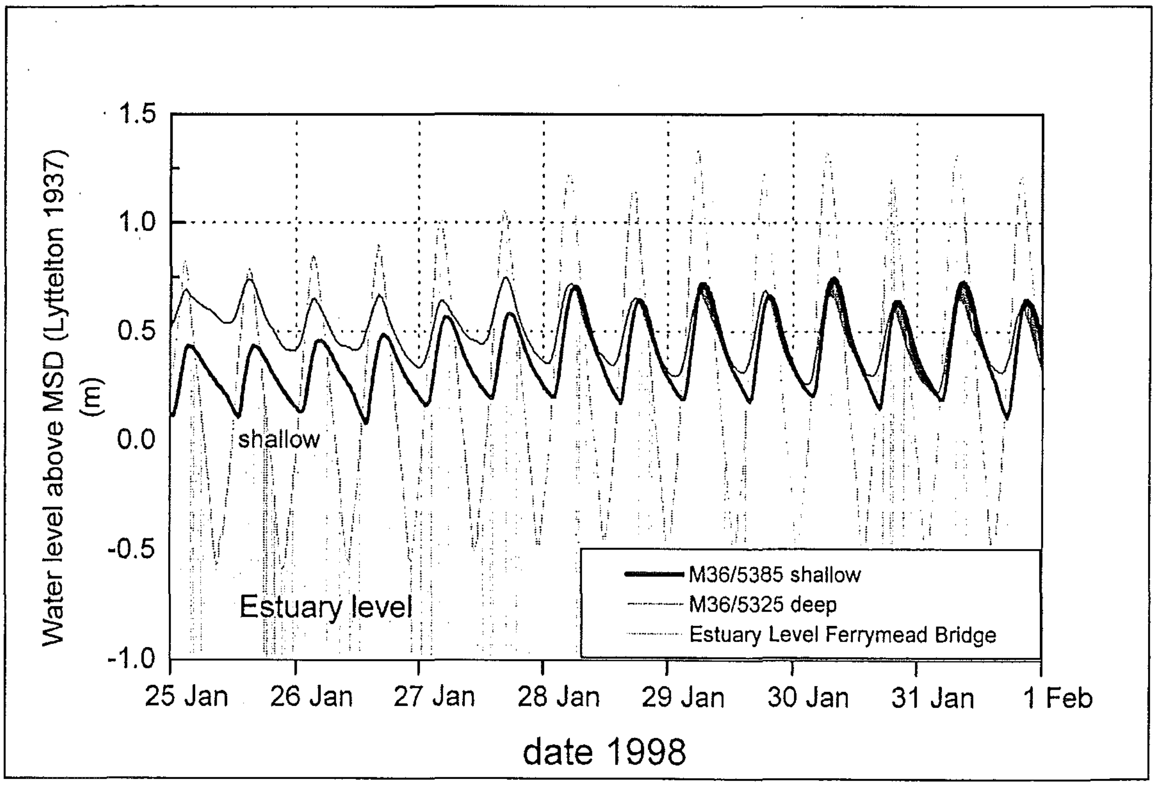



Water level above MSD (Lyttelton 1937) (m)
1.5
1.0
0.5
0.0
-0.5
-1.0
shallow
Estuary level
M36/5385 shallow
M36/5325 deep
Estuary Level Ferrymead Bridge
4 Jan
5 Jan
6 Jan
7 Jan
8 Jan
9 Jan
10 Jan
11 Jan
date 1998

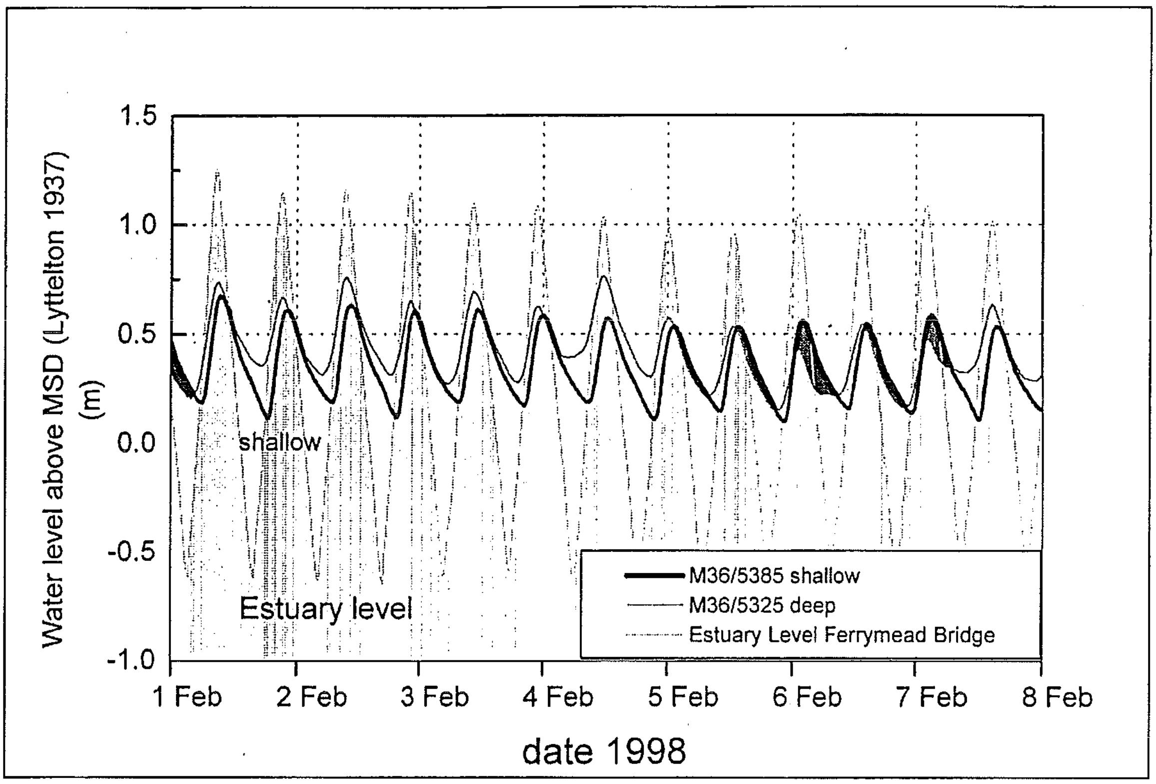

Water level above MSD (Lyttelton 1937) (m)
1.5
1.0
0.5
0.0
-0.5
-1.0
shallow
Estuary level
M36/5385 shallow
M36/5325 deep
Estuary Level Ferrymead Bridge
11 Jan
12 Jan
13 Jan
14 Jan
15 Jan
16 Jan
17 Jan
18 Jan
date 1998



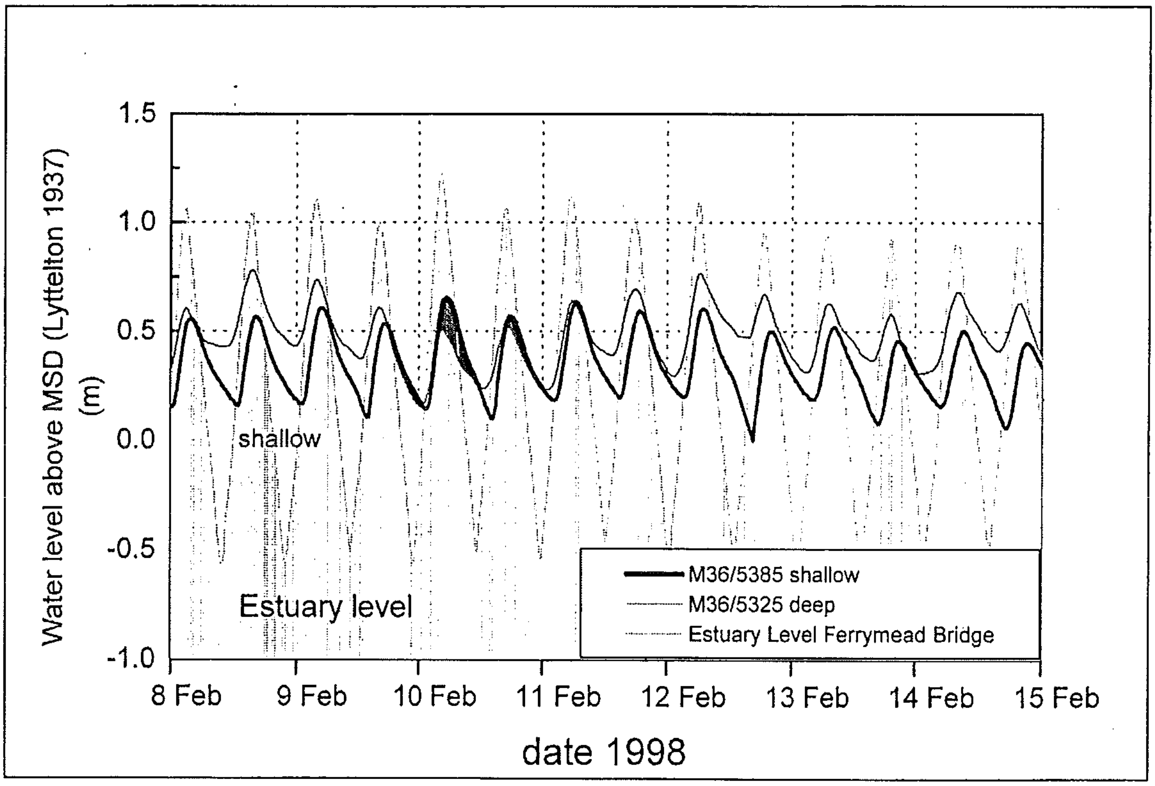
Water level above MSD (Lyttelton 1937) (m)
1.5
1.0
0.5
0.0
-0.5
-1.0
shallow
Estuary level
M36/5385 shallow
M36/5325 deep
Estuary Level Ferrymead Bridge
18 Jan
19 Jan
20 Jan
21 Jan
22 Jan
23 Jan
24 Jan
25 Jan
date 1998



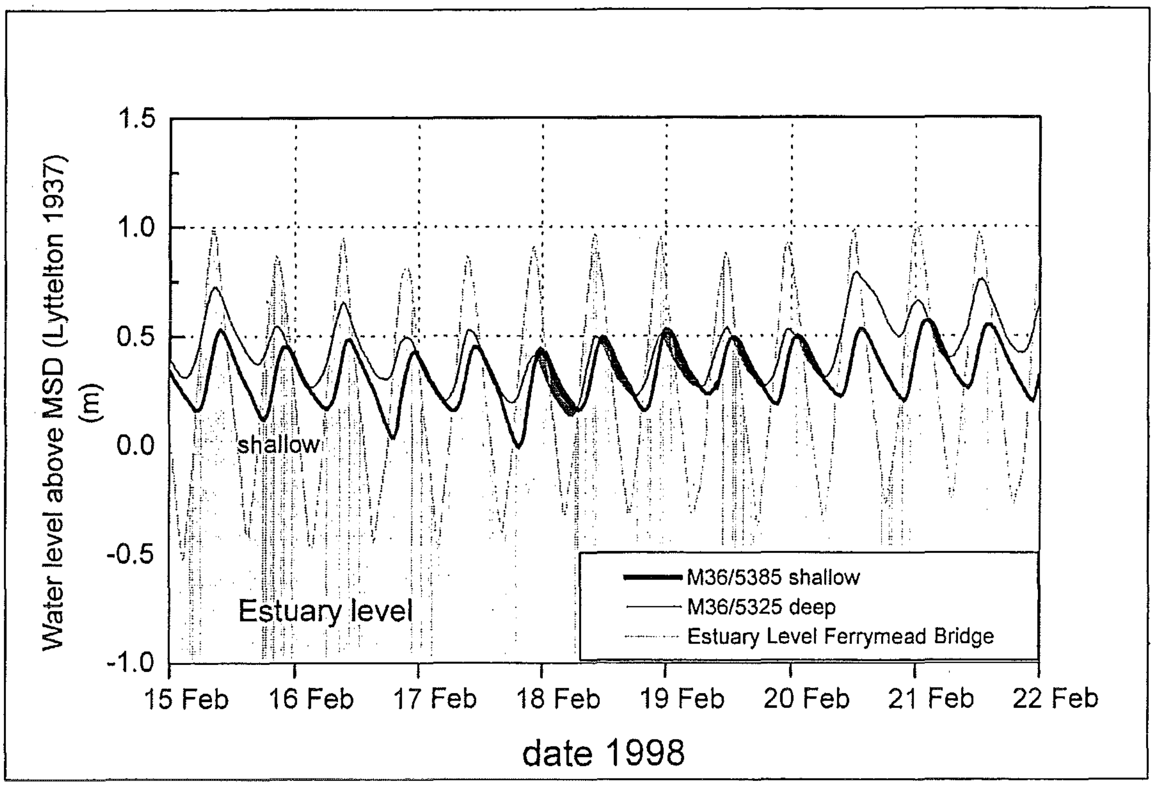
Water level above MSD (Lyttelton 1937) (m)
1.5
1.0
0.5
0.0
-0.5
-1.0
shallow
Estuary level
M36/5385 shallow
M36/5325 deep
Estuary Level Ferrymead Bridge
25 Jan
26 Jan
27 Jan
28 Jan
29 Jan
30 Jan
31 Jan
1 Feb
date 1998



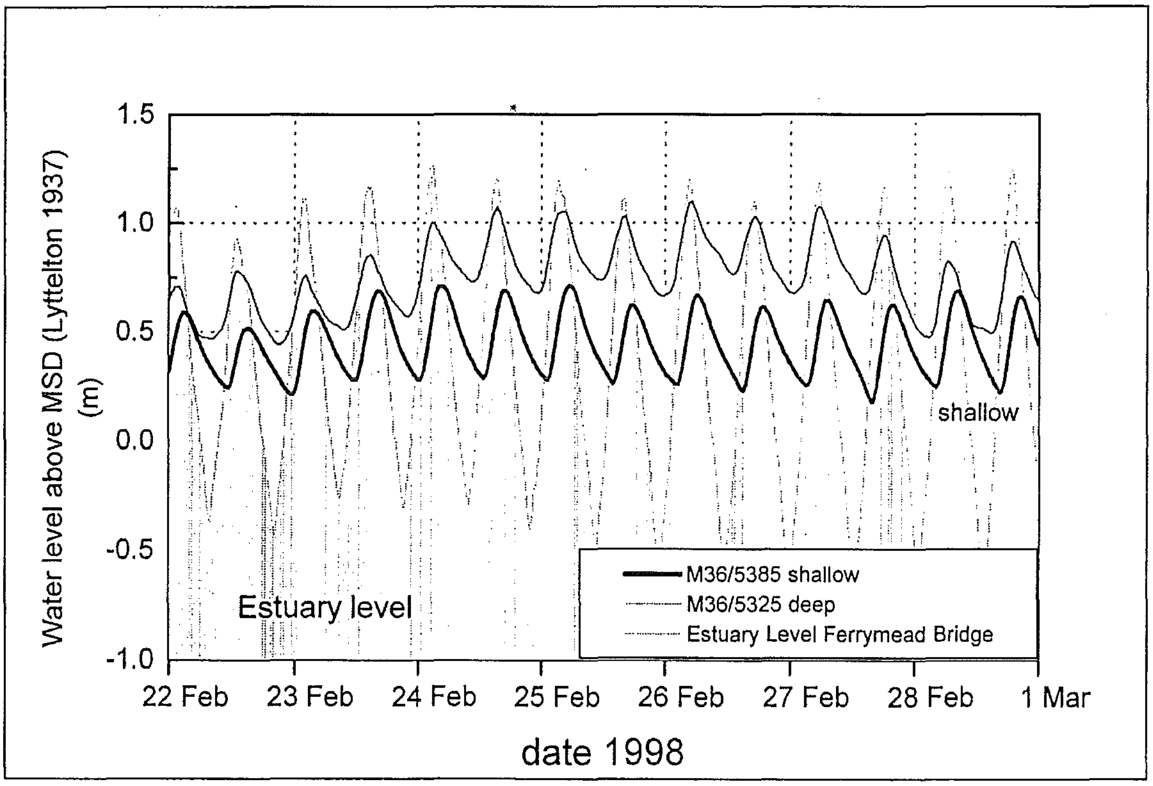
Water level above MSD (Lyttelton 1937) (m)
1.5
1.0
0.5
0.0
-0.5
-1.0
shallow
Estuary level
M36/5385 shallow
M36/5325 deep
Estuary Level Ferrymead Bridge
1 Feb
2 Feb
3 Feb
4 Feb
5 Feb
6 Feb
7 Feb
8 Feb
date 1998



Water level above MSD (Lyttelton 1937) (m)
1.5
1.0
0.5
0.0
-0.5
-1.0
shallow
Estuary level
M36/5385 shallow
M36/5325 deep
Estuary Level Ferrymead Bridge
8 Feb
9 Feb
10 Feb
11 Feb
12 Feb
13 Feb
14 Feb
15 Feb
date 1998



Water level above MSD (Lyttelton 1937) (m)
1.5
1.0
0.5
0.0
-0.5
-1.0
shallow
Estuary level
M36/5385 shallow
M36/5325 deep
Estuary Level Ferrymead Bridge
15 Feb
16 Feb
17 Feb
18 Feb
19 Feb
20 Feb
21 Feb
22 Feb
date 1998



Water level above MSD (Lyttelton 1937) (m)
1.5
1.0
0.5
0.0
-0.5
-1.0
shallow
Estuary level
M36/5385 shallow
M36/5325 deep
Estuary Level Ferrymead Bridge
22 Feb
23 Feb
24 Feb
25 Feb
26 Feb
27 Feb
28 Feb
1 Mar
date 1998

Appendix E.5 Water chemistry of samples taken at the water quality monitoring site at Humhrey's Drive (from CRC database)

QUALARC Canterbury Regional Council 15-May-98

SITE ID	CRC303880	M365385 (DEPTH = 6m)	SAMPLE ID	CRC985878
	M36:8600-3905	CRC, HUMPHREY'S DR, FERRYMEAD	FIELD SHEET	
PROJECT ID	CRCWOOLSTGW	WOOLSTON AREA GROUNDWATER SURV	REGISTERED BY	DIB
COST CENTRE	BCAS120		COMPLETION DATE	15-MAY-1998
USE CODE		Sample taken from confining layer (6m depth)	CHECKED BY	PHW

COLLECTION DATE: 12-FEB-1998 TIME: 1530 COLLECTED BY: I&S

ANALYSES COMPLETED:		METHOD	LAB	RESULT		Meter
DEPTH-9	Water Depth	Depth to groundwater	CRC	2.15	m	
GWPRGT-1	Water purging time	Timing	CRC	3	mins	
PH-6	pH	Hach One pH/ISE meter	CRC	8.6	pH	1
COND-1	Conductivity	Radiometer CDM 2e meter	CRC	750	mS/m @25'C	1
TOC-2	Total Organic Carbon	TOC Instrument	CDI	89	g/m3	
NO2-5	Nitrite Nitrogen	SFA, Sulphanilamide - NEDD	CRC	0.018	g/m3 N	
NO3-7	Nitrate Nitrogen	Calc. NNN(SFA) less NO3N(NEDD)	CRC	<0.5	g/m3 N	
NH3-6	Ammonia Nitrogen	Automated Gas Diffusion.	CRC	0.032	g/m3 N	
DRP-1	Dissolved Reactive Phosphorus	Ascorbic acid Mo-Sb reagent	CRC	0.13	g/m3 P	
HCO3-1	Bicarbonate Alkalinity	Titration to pH 4.5	CRC	620	g/m3 HCO3	1
BAS-4	Boron Acid soluble	ICPMS	CDG	1.9	gm-3	
BR-2	Bromide	Ion chromatography	CRC	0.75	g/m3 Br	
CL-6	Chloride	Ion chromatography	CRC	1980	g/m3 Cl	
CO2-1	Free Carbon Dioxide	Calculation on Casio PB110 P2	CRC	3	g/m3 CO2	
F-4	Fluoride	Ion chromatography	CRC	0.53	g/m3 F	
RSI-3	Reactive Silica	APHA 4500-Si F mod.	CRC	10	g/m3 SiO2	
SO4-4	Sulphate	Ion chromatography	CRC	380	g/m3 SO4	
CAAS-6	Calcium	Ion chromatography	CRC	24	g/m3 Ca	
MGAS-6	Magnesium Acid Soluble	Ion chromatography	CRC	54	g/m3 Mg	
NAAS-6	Sodium Acid Soluble	Ion chromatography	CRC	1600	g/m3 Na	
THD-1	Total Hardness	Calculation on Casio PB110 P3	CRC	282	g/m3 CaCO3	
ALAS-4	Aluminium Acid Soluble	ICPMS	CDG	0.43	g/m3 Al	
ASAS-4	Arsenic Acid Soluble	ICPMS	CDG	0.013	g/m3 As	
FEAS-4	Iron Acid Soluble	ICPMS	CDG	0.60	g/m3 Fe	
LIAS-4	Lithium Acid soluble	ICPMS	CDG	0.013	gm-3	
MNAS-4	Manganese Acid Soluble	ICPMS	CDG	0.033	g/m3 Mn	
NIAS-4	Nickel Acid Soluble	ICPMS	CDG	0.061	g/m3 Ni	
KAS-6	Potassium Acid Soluble	Ion chromatography	CRC	46	g/m3 K	
ZNAS-4	Zinc Acid Soluble	ICPMS	CDG	0.45	g/m3 Zn	
SRAS-4	Strontium Acid soluble	ICPMS	CDG	0.39	gm-3	
CATS-1	Sum of cations	Calculation (Sum Ca,Mg,Na,K)	CRC	76.412	meq/l	

ANS-1	Sum of anions	Calculation (Sum Cl, HCO3,NO3,	CRC	76.058 meq/l
IONB-1	Ion Balance (% error)	Calculation (% error)	CRC	0 %error

QUALARC Canterbury Regional Council 15-May-98

SITE ID	CRC303853	M365325 (Depth = 33m)	SAMPLE ID	CRC985879
	M36:8600-3905	CRC, HUMPREYS DR, FERRYMEAD	FIELD SHEET	
PROJECT ID	CRCWOOLSTGW	WOOLSTON AREA GROUNDWATER SURV	REGISTERED BY	DIB
COST CENTRE	BCAS120		COMPLETION DATE	15-MAY-1998
USE CODE		Sample taken from Aquifer 1 (33m depth)	CHECKED BY	PHW

COLLECTION DATE: 12-FEB-1998 TIME: 0000 COLLECTED BY: IH

ANALYSES COMPLETED:		METHOD	LAB	RESULT	Meter
DEPTH-9	Water Depth	Depth to groundwater	CRC	2.68 m	
GWPRGT-1	Water purging time	Timing	CRC	90 mins	
GWPRAT-1	Purging rate	Timing	CRC	0.5 l/s	
PH-6	pH	Hach One pH/ISE meter	CRC	7.6 pH	1
COND-1	Conductivity	Radiometer CDM 2e meter	CRC	14 mS/m @25'C	1
TOC-2	Total Organic Carbon	TOC Instrument	CDI	0.4 g/m3	
NO2-5	Nitrite Nitrogen	SFA, Sulphanilamide - NEDD	CRC	0.007 g/m3 N	
NO3-7	Nitrate Nitrogen	Calc. NNN(SFA) less NO3N(NEDD)	CRC	<0.025 g/m3 N	
NH3-6	Ammonia Nitrogen	Automated Gas Diffusion.	CRC	0.15 g/m3 N	
DRP-1	Dissolved Reactive Phosphorus	Ascorbic acid Mo-Sb reagent	CRC	0.010 g/m3 P	
HCO3-1	Bicarbonate Alkalinity	Titration to pH 4.5	CRC	78 g/m3 HCO3	1
BAS-4	Boron Acid soluble	ICPMS	CDG	0.044 gm-3	
BR-2	Bromide	Ion chromatography	CRC	<0.05 g/m3 Br	
CL-6	Chloride	Ion chromatography	CRC	4.0 g/m3 Cl	
CO2-1	Free Carbon Dioxide	Calculation on Casio PB110 P2	CRC	3 g/m3 CO2	
F-4	Fluoride	Ion chromatography	CRC	<0.1 g/m3 F	
RSI-3	Reactive Silica	APHA 4500-Si F mod.	CRC	21 g/m3 SiO2	
SO4-4	Sulphate	Ion chromatography	CRC	<0.1 g/m3 SO4	
CAAS-6	Calcium	Ion chromatography	CRC	7.3 g/m3 Ca	
MGAS-6	Magnesium Acid Soluble	Ion chromatography	CRC	5.9 g/m3 Mg	
NAAS-6	Sodium Acid Soluble	Ion chromatography	CRC	13 g/m3 Na	
THD-1	Total Hardness	Calculation on Casio PB110 P3	CRC	43 g/m3 CaCO3	
ALAS-4	Aluminium Acid Soluble	ICPMS	CDG	0.63 g/m3 Al	
ASAS-4	Arsenic Acid Soluble	ICPMS	CDG	0.00080 g/m3 As	
FEAS-4	Iron Acid Soluble	ICPMS	CDG	1.1 g/m3 Fe	
LIAS-4	Lithium Acid soluble	ICPMS	CDG	0.0075 gm-3	
MNAS-4	Manganese Acid Soluble	ICPMS	CDG	0.13 g/m3 Mn	
NIAS-4	Nickel Acid Soluble	ICPMS	CDG	0.0011 g/m3 Ni	
KAS-6	Potassium Acid Soluble	Ion chromatography	CRC	1.6 g/m3 K	
ZNAS-4	Zinc Acid Soluble	ICPMS	CDG	0.018 g/m3 Zn	
SRAS-4	Strontium Acid soluble	ICPMS	CDG	0.043 gm-3	

CATS-1	Sum of cations	Calculation (Sum Ca,Mg,Na,K)	CRC	1.456 meq/l
ANS-1	Sum of anions	Calculation (Sum Cl, HCO3,NO3,	CRC	1.391 meq/l
IONB-1	Ion Balance (% error)	Calculation (% error)	CRC	2 %error

QUALARC Canterbury Regional Council 25-May-98

SITE ID	CRC303853	M365325	SAMPLE ID	CRC972609
	M36:8600-3905	CRC, HUMPREYS DR, FERRYMEAD	FIELD SHEET	
PROJECT ID	CRCWOOLSTGW	WOOLSTON AREA GROUNDWATER SURV	REGISTERED BY	DIB
COST CENTRE	EMQ026800		COMPLETION DATE	20-FEB-1998
USE CODE			CHECKED BY	PHW

Sample taken from confining layer (12.35 depth)

COLLECTION DATE: 3-NOV-1997 TIME: 1520 COLLECTED BY: IH

COMMENT: SAMPLE TAKEN WHILE WELL DRILLED - 2ND TRY
HYDROC

ANALYSES COMPLETED:		METHOD	LAB	RESULT	Meter
DEPTH-9	Water Depth	Depth to groundwater	CRC	12.35 m	
PH-6	pH	Hach One pH/ISE meter	CRC	7.5 pH	1
COND-1	Conductivity	Radiometer CDM 2e meter	CRC	3600 mS/m @25'C	1
TOC-2	Total Organic Carbon	TOC Instrument	CDI	6.4 g/m3	
STYR-2	Styrene	GC with MS detection	CDG	<0.5 ug/l	
IPBENZ-2	Isopropylbenzene	GC with MS detection	CDG	<0.5 ug/l	
NPBENZ-2	n-Propylbenzene	GC with MS detection	CDG	<0.5 ug/l	
TMBZ35-2	1,3,5-Trimethylbenzene	GC with MS detection	CDG	<0.5 ug/l	
BBENZT-2	tert-Butylbenzene	GC with MS detection	CDG	<0.5 ug/l	
TMBZ24-2	1,2,4-Trimethylbenzene	GC with MS detection	CDG	<0.5 ug/l	
BBENZS-2	sec-Butylbenzene	GC with MS detection	CDG	<0.5 ug/l	
IPTOL4-2	4-Isopropyltoluene	GC with MS detection	CDG	<0.5 ug/l	
BBENZN-2	n-Butylbenzene	GC with MS detection	CDG	<0.5 ug/l	
NAPHTH-2	Naphthalene	GC with MS detection	CDG	<0.5 ug/l	
BRBENZ-2	Bromobenzene	GC with MS detection	CDG	<0.5 ug/l	
CHTOL2-2	2-Chlorotoluene	GC with MS detection	CDG	<0.5 ug/l	
CHTOL4-2	4-Chlorotoluene	GC with MS detection	CDG	<0.5 ug/l	
HEXCBE-2	Hexachlorobutadiene	GC with MS detection	CDG	<0.5 ug/l	
TRCB24-2	1,2,4-Trichlorobenzene	GC with MS detection	CDG	<0.5 ug/l	
TRCB23-2	1,2,3-Trichlorobenzene	GC with MS detection	CDG	<0.5 ug/l	
DICPA2-2	2,2-Dichloropropane	GC with MS detection	CDG	<0.5 ug/l	
DICE12-2	cis-1,2-Dichloroethene	GC with MS detection	CDG	<0.5 ug/l	
BRCHM-2	Bromochloromethane	GC with MS detection	CDG	<0.5 ug/l	
DICPE1-2	1,1-Dichloropropene	GC with MS detection	CDG	<0.5 ug/l	
DIBRM-2	Dibromomethane	GC with MS detection	CDG	<0.5 ug/l	
DICPA3-2	1,3-Dichloropropane	GC with MS detection	CDG	<0.5 ug/l	
DIBRE2-2	1,2-Dibromoethane	GC with MS detection	CDG	<0.5 ug/l	
TETC12-1	1,1,1,2-Tetrachloroethane	GC with MS detection	CDG	<0.5 ug/l	

TRCP23-2	1,2,3-Trichloropropane	GC with MS detection	CDG	<0.5	ug/l	
DI3CLP-2	1,2-Dibromo-3-chloropropane	GC with MS detection	CDG	<0.5	ug/l	
TRIBRA-2	Tribromomethane	GC with MS detection	CDG	<0.5	ug/l	
EBENZ-3	Ethylbenzene	GC with MS detection	CDG	<0.5	ug/l	
BENZ-3	Benzene	GC with MS detection	CDG	3.7	ug/l	
VINCL-2	Vinyl chloride	GC with MS detection	CDG	<1	ug/l	
BROMET-2	Bromomethane	GC with MS detection	CDG	<1	ug/l	
CHLETH-2	Chloroethane	GC with MS detection	CDG	<1	ug/l	
DICLME-2	Dichloromethane	GC with MS detection	CDG	<8	ug/l	
DICLET-2	trans 1,2-Dichloroethene	GC with MS detection	CDG	<0.5	ug/l	
DICHL1-2	1,1-Dichloroethane	GC with MS detection	CDG	<0.5	ug/l	
TRIMET-2	Trichloromethane	GC with MS detection	CDG	<0.5	ug/l	
DICLPR-2	cis 1,3-Dichloropropene	GC with MS detection	CDG	<0.5	ug/l	
DICLPO-2	trans 1,3-Dichloropropene	GC with MS detection	CDG	<0.5	ug/l	
CLBENZ-2	Chlorobenzene	GC with MS detection	CDG	<0.5	ug/l	
XYLMP-2	m+p-Xylene	GC with MS detection	CDG	<0.5	ug/l	
XYLO-2	o-Xylene	GC with MS detection	CDG	<0.5	ug/l	
TETCLE-2	1,1,2,2-Tetrachloroethane	GC with MS detection	CDG	<0.5	ug/l	
DICHLA-2	1,2-Dichloroethane	GC with MS detection	CDG	<0.5	ug/l	
DICHLE-2	1,1-Dichloroethene	GC with MS detection	CDG	<0.5	ug/l	
DICLPA-2	1,2-Dichloropropane	GC with MS detection	CDG	<0.5	ug/l	
TETCHM-2	Tetrachloromethane	GC with MS detection	CDG	<0.5	ug/l	
BROCHA-2	Bromodichloromethane	GC with MS detection	CDG	<0.5	ug/l	
TETCL-2	Tetrachloroethene	GC with MS detection	CDG	<0.5	ug/l	
CHLOBA-2	Chlorodibromomethane	GC with MS detection	CDG	<0.5	ug/l	
TOL-3	Toluene	GC with MS detection	CDG	5.3	ug/l	
TRICLA-2	1,1,1-Trichloroethane	GC with MS detection	CDG	<1	ug/l	
TRICL2-2	1,1,2-Trichloroethane	GC with MS detection	CDG	<0.5	ug/l	
TRICLE-2	Trichloroethene	GC with MS detection	CDG	<0.5	ug/l	
DICHB3-2	1,3-Dichlorobenzene	GC with MS detection	CDG	<0.5	ug/l	
DICHB4-2	1,4-Dichlorobenzene	GC with MS detection	CDG	<0.5	ug/l	
DICHB2-2	1,2-Dichlorobenzene	GC with MS detection	CDG	<0.5	ug/l	
NO2-5	Nitrite Nitrogen	SFA, Sulphanilamide - NEDD	CRC	0.38	g/m3 N	
NO3-6	Nitrate Nitrogen	Ion chromatography	CRC	<0.25	g/m3 N	
NH3-6	Ammonia Nitrogen	Automated Gas Diffusion.	CRC	0.64	g/m3 N	
DRP-1	Dissolved Reactive Phosphorus	Ascorbic acid Mo-Sb reagent	CRC	<0.003	g/m3 P	
HCO3-1	Bicarbonate Alkalinity	Titration to pH 4.5	CRC	180	g/m3 HCO3	1
BR-2	Bromide	Ion chromatography	CRC	41	g/m3 Br	
CL-6	Chloride	Ion chromatography	CRC	13000	g/m3 Cl	
CO2-1	Free Carbon Dioxide	Calculation on Casio PB110 P2	CRC	9	g/m3 CO2	
F-4	Fluoride	Ion chromatography	CRC	0.29	g/m3 F	
RSI-3	Reactive Silica	APHA 4500-Si F mod.	CRC	5.4	g/m3 SiO2	
SO4-4	Sulphate	Ion chromatography	CRC	1700	g/m3 SO4	

CAAS-1	Calcium	AAS direct aspiration Air-Ac	CRC	280	g/m3 Ca
MGAS-1	Magnesium Acid Soluble	AAS direct aspiration Air-Ac	CRC	850	g/m3 Mg
NAAS-1	Sodium Acid Soluble	Atomic emission Air-Ac flame	CRC	7300	g/m3 Na
THD-1	Total Hardness	Calculation on Casio PB110 P3	CRC	4199	g/m3 CaCO3
ALAE-1	Aluminium, Acid extractable	ICPMS	CDG	<0.2	g/m3
ASAE-1	Arsenic, Acid extractable	ICPMS	CDG	0.0023	g/m3
BAE-1	Boron, Acid extractable	ICPMS	CDG	1.0	g/m3
FEAS-1	Iron Acid Soluble	AAS direct aspiration Air-Ac	CRC	0.18	g/m3 Fe
LI-7	Lithium	Ion Chromatography	CRC	<5	g/m3
MNAS-1	Manganese Acid Soluble	AAS direct aspiration Air-Ac	CRC	0.95	g/m3 Mn
NIAE-1	Nickel, Acid extractable	ICPMS	CDG	0.012	g/m3
KAS-1	Potassium Acid Soluble	Atomic emission Air-Ac flame	CRC	270	g/m3 K
ZNAE-1	Zinc, acid extractable	ICPMS	CDG	0.013	g/m3
SRAE-1	Strontium, Acid extractable	ICPMS	CDG	5.3	g/m3
CATS-1	Sum of cations	Calculation (Sum Ca,Mg,Na,K)	CRC	408.545	meq/l
ANS-1	Sum of anions	Calculation (Sum Cl, HCO3,NO3,	CRC	405.572	meq/l
IONB-1	Ion Balance (% error)	Calculation (% error)	CRC	0	%error

QUALARC Canterbury Regional Council 25-May-98

SITE ID CRC303853 M365325
M36:8600-3905 CRC, HUMPREYS DR, FERRYMEAD
PROJECT ID CRCWOOLSTGW WOOLSTON AREA GROUNDWATER SURV
COST CENTRE EMQ026800
USE CODE Sample taken from confining layer (18.3 m depth)

SAMPLE ID CRC972610
FIELD SHEET
REGISTERED BY DIB
COMPLETION DATE 20-FEB-1998
CHECKED BY PHW

COLLECTION DATE: 3-NOV-1997 TIME: 1710 COLLECTED BY: IH

COMMENT: SAMPLE TAKEN WHILE WELL DRILLED - 2ND TRY
HYDROC

ANALYSES COMPLETED:		METHOD	LAB	RESULT	Meter
DEPTH-9	Water Depth	Depth to groundwater	CRC	18.3 m	
PH-6	pH	Hach One pH/ISE meter	CRC	7.6 pH	1
COND-1	Conductivity	Radiometer CDM 2e meter	CRC	3900 mS/m @25'C	1
TOC-2	Total Organic Carbon	TOC Instrument	CDI	3.6 g/m3	
STYR-2	Styrene	GC with MS detection	CDG	<0.5 ug/l	
STYR-2	Styrene	GC with MS detection	CDG	<0.5 ug/l	
IPBENZ-2	Isopropylbenzene	GC with MS detection	CDG	<0.5 ug/l	
NPBENZ-2	n-Propylbenzene	GC with MS detection	CDG	<0.5 ug/l	
TMBZ35-2	1,3,5-Trimethylbenzene	GC with MS detection	CDG	<0.5 ug/l	
BBENZT-2	tert-Butylbenzene	GC with MS detection	CDG	<0.5 ug/l	
TMBZ24-2	1,2,4-Trimethylbenzene	GC with MS detection	CDG	<0.5 ug/l	
BBENZS-2	sec-Butylbenzene	GC with MS detection	CDG	<0.5 ug/l	
IPTOL4-2	4-Isopropyltoluene	GC with MS detection	CDG	<0.5 ug/l	
BBENZN-2	n-Butylbenzene	GC with MS detection	CDG	<0.5 ug/l	
NAPHTH-2	Naphthalene	GC with MS detection	CDG	<0.5 ug/l	
BRBENZ-2	Bromobenzene	GC with MS detection	CDG	<0.5 ug/l	
CHTOL2-2	2-Chlorotoluene	GC with MS detection	CDG	<0.5 ug/l	
CHTOL4-2	4-Chlorotoluene	GC with MS detection	CDG	<0.5 ug/l	
HEXCBE-2	Hexachlorobutadiene	GC with MS detection	CDG	<0.5 ug/l	
TRCB24-2	1,2,4-Trichlorobenzene	GC with MS detection	CDG	<0.5 ug/l	
TRCB23-2	1,2,3-Trichlorobenzene	GC with MS detection	CDG	<0.5 ug/l	
DICPA2-2	2,2-Dichloropropane	GC with MS detection	CDG	<0.5 ug/l	
DICE12-2	cis-1,2-Dichloroethene	GC with MS detection	CDG	<0.5 ug/l	
BRCHM-2	Bromochloromethane	GC with MS detection	CDG	<0.5 ug/l	
DICPE1-2	1,1-Dichloropropene	GC with MS detection	CDG	<0.5 ug/l	
DIBRM-2	Dibromomethane	GC with MS detection	CDG	<0.5 ug/l	
DICPA3-2	1,3-Dichloropropane	GC with MS detection	CDG	<0.5 ug/l	
DIBRE2-2	1,2-Dibromoethane	GC with MS detection	CDG	<0.5 ug/l	

TETCl2-1	1,1,1,2-Tetrachloroethane	GC with MS detection	CDG	<0.5	ug/l		
TRCP23-2	1,2,3-Trichloropropane	GC with MS detection	CDG	<0.5	ug/l		
DI3CLP-2	1,2-Dibromo-3-chloropropane	GC with MS detection	CDG	<0.5	ug/l		
TRIBRA-2	Tribromomethane	GC with MS detection	CDG	<0.5	ug/l		
EBENZ-3	Ethylbenzene	GC with MS detection	CDG	<0.5	ug/l		
BENZ-3	Benzene	GC with MS detection	CDG	2.5	ug/l		
VINCL-2	Vinyl chloride	GC with MS detection	CDG	<1	ug/l		
BROMET-2	Bromomethane	GC with MS detection	CDG	<1	ug/l		
CHLETH-2	Chloroethane	GC with MS detection	CDG	<1	ug/l		
DICLME-2	Dichloromethane	GC with MS detection	CDG	<8	ug/l		
DICLET-2	trans 1,2-Dichloroethene	GC with MS detection	CDG	<0.5	ug/l		
DICHL1-2	1,1-Dichloroethane	GC with MS detection	CDG	<0.5	ug/l		
TRIMET-2	Trichloromethane	GC with MS detection	CDG	<0.5	ug/l		
DICLPR-2	cis 1,3-Dichloropropene	GC with MS detection	CDG	<0.5	ug/l		
DICLPO-2	trans 1,3-Dichloropropene	GC with MS detection	CDG	<0.5	ug/l		
CLBENZ-2	Chlorobenzene	GC with MS detection	CDG	<0.5	ug/l		
XYLMP-2	m+p-Xylene	GC with MS detection	CDG	<0.5	ug/l		
XYLO-2	o-Xylene	GC with MS detection	CDG	0.8	ug/l		
TETCLE-2	1,1,2,2-Tetrachloroethane	GC with MS detection	CDG	<0.5	ug/l		
DICHLA-2	1,2-Dichloroethane	GC with MS detection	CDG	<0.5	ug/l		
DICHLE-2	1,1-Dichloroethene	GC with MS detection	CDG	<0.5	ug/l		
DICLPA-2	1,2-Dichloropropane	GC with MS detection	CDG	<0.5	ug/l		
TETCHM-2	Tetrachloromethane	GC with MS detection	CDG	<0.5	ug/l		
BROCHA-2	Bromodichloromethane	GC with MS detection	CDG	<0.5	ug/l		
TETCL-2	Tetrachloroethene	GC with MS detection	CDG	<0.5	ug/l		
CHLOBA-2	Chlorodibromomethane	GC with MS detection	CDG	<0.5	ug/l		
TOL-3	Toluene	GC with MS detection	CDG	<0.5	ug/l		
TRICLA-2	1,1,1-Trichloroethane	GC with MS detection	CDG	5.0	ug/l		
TRICL2-2	1,1,2-Trichloroethane	GC with MS detection	CDG	<1	ug/l		
TRICLE-2	Trichloroethene	GC with MS detection	CDG	<0.5	ug/l		
DICHB3-2	1,3-Dichlorobenzene	GC with MS detection	CDG	<0.5	ug/l		
DICHB4-2	1,4-Dichlorobenzene	GC with MS detection	CDG	<0.5	ug/l		
DICHB2-2	1,2-Dichlorobenzene	GC with MS detection	CDG	<0.5	ug/l		
NO2-5	Nitrite Nitrogen	SFA, Sulphanilamide - NEDD	CRC	0.36	g/m3	N	
NO3-6	Nitrate Nitrogen	Ion chromatography	CRC	<0.25	g/m3	N	
NH3-6	Ammonia Nitrogen	Automated Gas Diffusion.	CRC	3.9	g/m3	N	
DRP-1	Dissolved Reactive Phosphorus	Ascorbic acid Mo-Sb reagent	CRC	<0.003	g/m3	P	
HCO3-1	Bicarbonate Alkalinity	Titration to pH 4.5	CRC	130	g/m3	HCO3	1
BR-2	Bromide	Ion chromatography	CRC	44	g/m3	Br	
CL-6	Chloride	Ion chromatography	CRC	13000	g/m3	Cl	
CO2-1	Free Carbon Dioxide	Calculation on Casio PB110 P2	CRC	5	g/m3	CO2	
F-4	Fluoride	Ion chromatography	CRC	0.10	g/m3	F	
RSI-3	Reactive Silica	APHA 4500-Si F mod.	CRC	2.2	g/m3	SiO2	

SO4-4	Sulphate	Ion chromatography	CRC	1800	g/m3	SO4
CAAS-1	Calcium	AAS direct aspiration Air-Ac	CRC	340	g/m3	Ca
MGAS-1	Magnesium Acid Soluble	AAS direct aspiration Air-Ac	CRC	880	g/m3	Mg
NAAS-1	Sodium Acid Soluble	Atomic emission Air-Ac flame	CRC	7700	g/m3	Na
THD-1	Total Hardness	Calculation on Casio PB110 P3	CRC	4473	g/m3	CaCO3
ALAE-1	Aluminium, Acid extractable	ICPMS	CDG	<0.2	g/m3	
ASAE-1	Arsenic, Acid extractable	ICPMS	CDG	<0.002	g/m3	
BAE-1	Boron, Acid extractable	ICPMS	CDG	0.86	g/m3	
FEAS-1	Iron Acid Soluble	AAS direct aspiration Air-Ac	CRC	2.3	g/m3	Fe
LI-7	Lithium	Ion Chromatography	CRC	<5	g/m3	
MNAS-1	Manganese Acid Soluble	AAS direct aspiration Air-Ac	CRC	1.3	g/m3	Mn
NIAE-1	Nickel, Acid extractable	ICPMS	CDG	0.0021	g/m3	
KAS-1	Potassium Acid Soluble	Atomic emission Air-Ac flame	CRC	290	g/m3	K
ZNAE-1	Zinc, acid extractable	ICPMS	CDG	<0.02	g/m3	
SRAE-1	Strontium, Acid extractable	ICPMS	CDG	6.1	g/m3	
CATS-1	Sum of cations	Calculation (Sum Ca,Mg,Na,K)	CRC	432.257	meq/l	
ANS-1	Sum of anions	Calculation (Sum Cl, HCO3,NO3,	CRC	406.872	meq/l	
IONB-1	Ion Balance (% error)	Calculation (% error)	CRC	3	%error	

Appendix F.1 Starting head arrays.

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Basic Package translator - (c) 1994 Waterloo Hydrogeologic Software
FINAL.BAS Tue Jun  9 09:06:46 1998
         5        32        30         1         4
 11 12  0  0  0  0  0  0  0  0  0 22  0  0  0  0  0  0  0  0 24 23  0  0
         0         1
         1         1(40I2)                  -1 Bnd for Layer 1
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 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1-1-1-1-1-1-1-1-1-1-1-1-1
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 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1-1-1-1-1-1-1-1-1-1-1-1
 1 1 1 1 1 1 1 1 1 1 1-1-1-1-1 1 1 1 1-1-1-1-1-1-1-1-1-1-1-1
 1 1 1 1 1 1 1 1 1 1 1-1 1 1 1-1-1 1 1-1-1-1-1-1-1-1-1-1-1-1
 1 1 1 1 1 1 1 1 1 1 1-1 1 1 1 1-1-1 1-1-1-1-1-1-1-1-1-1-1-1
 1 1 1 1 1 1 1 1-1-1 1-1 1 1 1 1 1 1-1 1-1-1-1-1-1-1-1-1-1-1
 1 1 1 1 1 1 1 1-1-1-1-1 1 1 1 1 1 1-1 1-1-1-1-1-1-1-1-1-1-1
 1 1 1 1 1-1-1 1-1-1-1 1 1 1 1 1 1 1-1 1-1-1-1-1-1-1-1-1-1-1
 1 1 1 1-1-1-1-1-1 1 1 1 1 1 1 1 1-1-1-1 1-1-1-1-1-1-1-1-1-1
 1 1 1-1-1 1 1 1 1 1 1 1 1 1 1 1-1-1-1-1 1-1-1-1-1-1-1-1-1-1
 1 1 1-1 1 1 1 1 1 1 1 1 1 1 1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1
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 1 1 1 1 1 1-1-1 1-1-1-1-1-1 1-1-1-1-1-1-1-1 1-1-1-1-1-1-1-1
 1 1 1 1 1 1-1-1-1 1 1-1-1-1-1-1 0 0 0 0 0-1-1-1-1-1-1-1-1-1
 1 1 1 1-1-1-1-1-1 0 1 1 1 1 1 1 0 0 0 0 0 0-1-1-1-1-1-1-1-1
 1 1 1 1-1-1 1 1 0 0 0 1 1 1 1 1 0 0 0 0 0 0 0 0-1-1-1-1-1-1
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         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
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         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5          0.          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5          0.          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5          0.          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5      2.3127      2.0982     1.88371     1.66921         3.5         3.5         3.5         3.5          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5     2.52494         3.5         3.5         3.5     1.36746     1.15296         3.5         3.5          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5     2.73717         3.5         3.5         3.5         3.5 9.40723e-1  7.26227e-1         3.5          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5     4.44185     4.22736
         3.5     2.94941         3.5         3.5         3.5         3.5         3.5         3.5  4.24476e-1         3.5
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5     4.65409     4.01512
     3.37615     3.16165         3.5         3.5         3.5         3.5         3.5         3.5  2.12238e-1         3.5
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5     5.93429      5.7198         3.5     4.86633     3.80288
     3.58838         3.5         3.5         3.5         3.5         3.5         3.5         3.5          0.         3.5
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5     6.36103     6.14653     5.50756     5.29306     5.07857         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5          0.          0.          0.
         3.5          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5     6.78776     6.57327         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5          0.          0.          0.          0.
         3.5          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5          7.         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5          0.          0.          0.          0.          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5          0.          0.          0.          0.          0.          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
```

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         3.5         3.5         3.5         3.5          0.          0.          0.          0.          0.          0.
          0.         3.5          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5  7.92815e-1
  7.21232e-1         3.5         3.5         3.5         3.5          0.          0.          0.          0.          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5        1.32     1.24842         3.5  8.63644e-1
  6.50403e-1   5.7882e-1  3.65578e-1  2.93995e-1         3.5          0.          0.          0.          0.          0.
          0.          0.         3.5          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         1.4     1.17759  9.64346e-1         3.5
         3.5   5.0799e-1  4.36408e-1  2.23166e-1  1.51583e-1       8.e-2         3.5         3.5         3.5         3.5
         3.5          0.          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         1.8     1.53371        1.48     1.10676     1.03518         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5          0.          0.          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5     1.74686     1.69314         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5          0.          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5        1.64         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5          0.          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5          0.          0.          0.          0.
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5          0.         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
0        3.5 (10G12.5)                    -1 Starting Head for Layer 2
1         1. (10G12.5)                    -1 Starting Head for Layer 3
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5        1.37         3.5         3.5         3.5
         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5         3.5
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3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  1.37  3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  1.37  3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  1.37  3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  1.37  3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  1.37  3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  1.37  3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  1.37  3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
0    3.5 (10G12.5)      -1 Starting Head for Layer 4
1     1. (10G12.5)      -1 Starting Head for Layer 5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
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3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
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3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  2.28  3.5
3.5  3.5  3.5  3.5  3.5  3.5  3.5   3.5  3.5   3.5
```

3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	2.28	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	2.28	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
1.	1	1.							

Appendix F.2 Recharge and abstraction wells.

708	50		
696			
3	2	1	1.296e3
3	3	1	1.296e3
3	4	1	1.296e3
3	5	1	1.296e3
3	6	1	1.296e3
3	7	1	1.296e3
3	8	1	1.8e3
3	9	1	1.8e3
3	10	1	1.8e3
3	11	1	1.8e3
3	12	1	1.8e3
3	13	1	1.8e3
3	14	1	1.8e3
3	15	1	1.8e3
3	16	1	1.8e3
3	17	1	1.8e3
3	18	1	1.8e3
3	19	1	1.8e3
3	20	1	1.8e3
3	21	1	1.8e3
3	22	1	1.8e3
5	2	1	1.796e3
4	2	1	7.41e-5
5	3	1	1.796e3
5	4	1	1.796e3
5	5	1	1.796e3
5	6	1	1.796e3
5	7	1	1.796e3
5	8	1	1.796e3
5	9	1	1.148e3
4	9	1	4.9996e-3
5	10	1	1.148e3
5	11	1	1.148e3
4	11	1	3.8193e-4
5	12	1	1.148e3
4	12	1	2.2162e-3
5	13	1	1.148e3
5	14	1	1.148e3
5	15	1	1.148e3
5	16	1	1.148e3
4	16	1	3.5842e-3
5	17	1	1.148e3
4	17	1	7.4554e-3
5	18	1	1.148e3
5	19	1	1.148e3
4	19	1	5.8479e-3
5	20	1	1.148e3
4	20	1	1.7541e-3
5	21	1	1.148e3
5	22	1	1.148e3
4	22	1	3.3336e-3
3	18	12	-1.213e3
2	18	12	-1.093e-3
3	17	12	-2.12e2
5	17	12	3.95e2
4	17	12	-2.584e-4
3	20	13	-2.863e3
3	19	12	-1.253e3
3	18	11	-3.622e3
5	18	12	-1.53e2
5	4	10	-6.e2
5	7	17	1.9e1
5	6	7	-3.811e3
3	9	9	-4.026e3
5	7	9	-3.526e3
5	11	16	-5.74e2
4	11	16	-1.214e-3
5	8	11	4.871e2
3	20	6	-2.45e2
3	20	4	-4.25e2
3	17	4	-3.24e1
5	2	2	5.e2
4	2	2	3.3099e-4
5	2	3	5.e2
5	2	4	5.e2
5	2	5	5.e2
5	2	6	5.e2
5	2	7	5.e2
5	2	8	5.e2
5	2	9	5.e2
5	2	10	5.e2
4	2	10	9.3352e-5
5	2	11	5.e2
5	2	12	5.e2
4	2	12	3.3127e-4
5	2	13	5.e2
4	2	13	8.5814e-5
5	2	14	5.e2
5	2	15	5.e2
4	2	15	6.9736e-4
5	2	16	5.e2
5	2	17	5.e2
5	2	18	5.e2
5	2	19	5.e2
5	2	20	5.e2
5	2	21	5.e2
4	2	21	2.4376e-5
5	2	22	5.e2
5	2	23	5.e2
5	2	24	5.e2
5	2	25	6.e2
5	2	26	5.e2
4	2	26	8.2378e-4
5	2	27	5.e2
5	2	28	5.e2
5	2	29	5.e2

7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2

11 1. (10G11.4) -1 Aquifer Bottom - 1

-1.976e1	-1.9779e1	-1.98e1	-1.9822e1	-1.9842e1	-1.9858e1	-2.0945e1	-2.1159e1	-2.1017e1	-2.6904e1
-2.7194e1	-2.8605e1	-2.8224e1	-2.8473e1	-2.8619e1	-3.0485e1	-3.1919e1	-3.2855e1	-3.3323e1	-3.3543e1
-3.365e1	-3.3705e1	-3.3998e1	-3.5341e1	-3.5379e1	-3.541e1	-3.5435e1	-3.5456e1	-3.5473e1	-3.5487e1
-1.9749e1	-1.9771e1	-1.9798e1	-1.9826e1	-1.9853e1	-1.9873e1	-2.0742e1	-2.0971e1	-2.1381e1	-2.6978e1
-2.7394e1	-2.7469e1	-2.7983e1	-2.717e1	-2.7297e1	-2.9806e1	-3.2241e1	-3.3346e1	-3.3708e1	-3.3822e1
-3.386e1	-3.5224e1	-3.5295e1	-3.5349e1	-3.539e1	-3.5422e1	-3.5447e1	-3.5467e1	-3.5483e1	-3.5496e1
-1.973e1	-1.9756e1	-1.979e1	-1.9827e1	-1.9864e1	-1.9892e1	-2.0503e1	-2.0729e1	-2.123e1	-2.5898e1
-2.7727e1	-2.7861e1	-2.8122e1	-2.6931e1	-2.6595e1	-3.0111e1	-3.3157e1	-3.4003e1	-3.4106e1	-3.4967e1
-3.5123e1	-3.5236e1	-3.5314e1	-3.537e1	-3.541e1	-3.544e1	-3.5464e1	-3.5482e1	-3.5496e1	-3.5508e1
-1.8905e1	-1.9729e1	-1.9769e1	-1.982e1	-1.9873e1	-1.9913e1	-2.0158e1	-2.0448e1	-2.1033e1	-2.6132e1
-2.8209e1	-2.8477e1	-2.8861e1	-2.8043e1	-2.899e1	-3.2144e1	-3.4043e1	-3.444e1	-3.4681e1	-3.4977e1
-3.5167e1	-3.5283e1	-3.5357e1	-3.5406e1	-3.544e1	-3.5466e1	-3.5485e1	-3.55e1	-3.5496e1	-3.5506e1
-1.8832e1	-1.887e1	-1.9724e1	-1.9792e1	-1.9872e1	-1.9933e1	-2.0041e1	-2.0117e1	-2.0833e1	-2.6479e1
-2.8372e1	-2.9081e1	-2.9356e1	-2.9324e1	-3.2606e1	-3.4812e1	-3.5079e1	-3.4674e1	-3.4911e1	-3.5158e1
-3.5294e1	-3.5373e1	-3.5422e1	-3.5455e1	-3.5479e1	-3.5497e1	-3.5495e1	-3.5506e1	-3.5515e1	-3.5522e1
-1.8155e1	-1.8752e1	-1.8793e1	-1.892e1	-1.9832e1	-1.9909e1	-1.9971e1	-2.0091e1	-2.0449e1	-2.6798e1
-2.9124e1	-2.9384e1	-2.9434e1	-3.0408e1	-3.4734e1	-3.553e1	-3.5673e1	-3.5778e1	-3.5565e1	-3.5485e1
-3.548e1	-3.5491e1	-3.5503e1	-3.5514e1	-3.5524e1	-3.5516e1	-3.5523e1	-3.5529e1	-3.5534e1	-3.5538e1
-1.8075e1	-1.813e1	-1.8206e1	-1.8626e1	-1.8819e1	-1.9772e1	-2.0179e1	-2.0504e1	-2.3827e1	-2.7767e1
-2.8892e1	-2.9272e1	-2.941e1	-3.0627e1	-3.5505e1	-3.5414e1	-3.5703e1	-3.5904e1	-3.5765e1	-3.5703e1
-3.5654e1	-3.5607e1	-3.5585e1	-3.5558e1	-3.5553e1	-3.5552e1	-3.5551e1	-3.5552e1	-3.5552e1	-3.5554e1
-1.6988e1	-1.8027e1	-1.8131e1	-1.824e1	-1.8397e1	-1.8705e1	-2.3843e1	-2.4395e1	-2.4527e1	-2.5141e1
-2.8108e1	-2.8482e1	-2.8424e1	-3.1028e1	-3.5204e1	-3.5416e1	-3.5443e1	-3.5631e1	-3.5662e1	-3.5655e1
-3.5646e1	-3.5639e1	-3.5614e1	-3.5791e1	-3.5162e1	-3.5158e1	-3.5155e1	-3.5152e1	-3.5149e1	-3.5146e1
-1.6782e1	-1.7091e1	-1.7562e1	-1.8169e1	-1.8162e1	-1.9245e1	-2.3985e1	-2.4616e1	-2.4719e1	-2.4651e1
-2.451e1	-2.654e1	-2.6787e1	-3.2301e1	-3.4227e1	-3.4433e1	-3.5175e1	-3.5427e1	-3.5563e1	-3.5604e1
-3.5599e1	-3.5599e1	-3.5598e1	-3.5596e1	-3.5595e1	-3.5769e1	-3.5767e1	-3.5178e1	-3.5171e1	-3.5165e1
-1.6422e1	-1.6606e1	-1.6821e1	-1.7248e1	-1.8053e1	-1.8243e1	-2.4059e1	-2.4552e1	-2.466e1	-2.4595e1
-2.4408e1	-2.434e1	-2.7069e1	-3.1224e1	-3.3827e1	-3.4149e1	-3.4597e1	-3.4893e1	-3.5034e1	-3.5558e1
-3.5574e1	-3.558e1	-3.5583e1	-3.5585e1	-3.5586e1	-3.5587e1	-3.5588e1	-3.5588e1	-3.5763e1	-3.5764e1
-1.5935e1	-1.5958e1	-1.6067e1	-1.617e1	-1.6236e1	-1.8686e1	-2.1838e1	-2.3429e1	-2.4251e1	-2.4525e1
-2.4541e1	-2.4534e1	-2.5989e1	-3.1102e1	-3.3725e1	-3.4097e1	-3.4333e1	-3.4472e1	-3.4722e1	-3.4968e1
-3.5097e1	-3.5666e1	-3.5572e1	-3.5576e1	-3.5579e1	-3.5581e1	-3.5583e1	-3.5584e1	-3.5584e1	-3.5585e1
-1.4188e1	-1.4177e1	-1.408e1	-1.3097e1	-1.3492e1	-1.9177e1	-2.1247e1	-2.2085e1	-2.2697e1	-2.3243e1
-2.447e1	-2.4972e1	-2.6544e1	-2.9771e1	-3.2452e1	-3.3662e1	-3.3694e1	-3.4527e1	-3.4905e1	-3.5276e1
-3.5374e1	-3.528e1	-3.516e1	-3.5673e1	-3.5699e1	-3.5577e1	-3.5579e1	-3.558e1	-3.5581e1	-3.5582e1
-1.4075e1	-1.3919e1	-1.3465e1	-1.1787e1	-1.1289e1	-1.8996e1	-2.1976e1	-2.2462e1	-2.3339e1	-2.2685e1
-2.3641e1	-2.5112e1	-2.6903e1	-2.7287e1	-3.0316e1	-3.176e1	-3.332e1	-3.3824e1	-3.5093e1	-3.549e1
-3.5536e1	-3.5383e1	-3.5224e1	-3.5104e1	-3.5017e1	-3.523e1	-3.5716e1	-3.5729e1	-3.5579e1	-3.558e1
-1.4094e1	-1.4044e1	-1.4364e1	-1.5216e1	-1.5619e1	-1.9307e1	-2.1329e1	-2.3504e1	-2.3859e1	-2.0682e1
-2.1888e1	-2.5377e1	-2.6792e1	-2.6613e1	-2.5478e1	-2.5161e1	-2.7657e1	-3.2996e1	-3.4149e1	-3.5083e1
-3.5458e1	-3.535e1	-3.5216e1	-3.5106e1	-3.5022e1	-3.496e1	-3.4912e1	-3.5187e1	-3.5729e1	-3.5739e1
-1.5235e1	-1.5314e1	-1.5442e1	-1.5609e1	-1.5916e1	-1.8368e1	-2.1458e1	-2.276e1	-2.011e1	-1.7746e1
-1.9305e1	-2.2346e1	-2.6985e1	-2.5957e1	-2.485e1	-2.4827e1	-2.4933e1	-2.7427e1	-3.0616e1	-3.2558e1
-3.3284e1	-3.3081e1	-3.423e1	-3.5074e1	-3.5006e1	-3.4951e1	-3.4908e1	-3.4873e1	-3.4845e1	-3.5158e1
-1.5865e1	-1.6307e1	-1.7068e1	-1.8716e1	-1.8367e1	-1.8942e1	-1.7912e1	-1.6904e1	-1.6753e1	-1.748e1
-2.0139e1	-2.0509e1	-2.577e1	-2.536e1	-2.4177e1	-2.4597e1	-2.4831e1	-2.6535e1	-2.8269e1	-2.993e1
-3.1498e1	-3.1739e1	-3.1609e1	-3.1345e1	-3.1061e1	-3.0801e1	-3.0649e1	-3.3478e1	-3.484e1	-3.4819e1
-1.7536e1	-1.7945e1	-1.8828e1	-2.0241e1	-1.9505e1	-1.794e1	-1.6865e1	-1.5916e1	-1.5927e1	-1.923e1
-2.2696e1	-1.837e1	-1.9759e1	-2.4998e1	-2.4463e1	-2.4652e1	-2.4836e1	-2.6083e1	-2.7275e1	-2.8478e1
-2.9363e1	-2.9816e1	-3.069e1	-3.0658e1	-3.0546e1	-3.0407e1	-3.0267e1	-3.0207e1	-3.0099e1	-3.0002e1
-1.7087e1	-1.7311e1	-1.7829e1	-1.8489e1	-1.7479e1	-1.6114e1	-1.5226e1	-1.6158e1	-1.711e1	-2.0724e1
-2.501e1	-2.4847e1	-2.1435e1	-2.1306e1	-2.4869e1	-2.4848e1	-2.4921e1	-2.4999e1	-2.6757e1	-2.7628e1

-2.8356e1	-2.8843e1	-2.9096e1	-2.9179e1	-3.0052e1	-3.0016e1	-2.9953e1	-2.9881e1	-2.9806e1	-2.9813e1
-1.6519e1	-1.6371e1	-1.6045e1	-1.5104e1	-1.4372e1	-1.4474e1	-1.4586e1	-1.5179e1	-1.8633e1	-2.1247e1
-2.3846e1	-2.3361e1	-2.271e1	-2.2151e1	-2.2644e1	-2.4262e1	-2.4311e1	-2.4346e1	-2.6507e1	-2.7149e1
-2.7727e1	-2.8171e1	-2.8465e1	-2.8628e1	-2.8695e1	-2.8699e1	-2.8665e1	-2.9632e1	-2.9597e1	-2.9557e1
-1.601e1	-1.5615e1	-1.4719e1	-1.3969e1	-1.4265e1	-1.3593e1	-1.4065e1	-1.4697e1	-1.9522e1	-2.242e1
-2.3127e1	-2.293e1	-2.2844e1	-2.249e1	-2.2531e1	-2.2648e1	-2.4257e1	-2.4308e1	-2.4342e1	-2.6104e1
-2.6601e1	-2.7017e1	-2.7328e1	-2.8198e1	-2.8313e1	-2.8369e1	-2.8384e1	-2.8372e1	-2.8344e1	-2.9386e1
-1.5674e1	-1.4883e1	-1.4471e1	-1.3891e1	-1.346e1	-1.3683e1	-1.3921e1	-1.4415e1	-1.6447e1	-2.2336e1
-2.2864e1	-2.2811e1	-2.2712e1	-2.2505e1	-2.3214e1	-2.2553e1	-2.2616e1	-2.4273e1	-2.4315e1	-2.5855e1
-2.6265e1	-2.6625e1	-2.6917e1	-2.7135e1	-2.7285e1	-2.738e1	-2.7432e1	-2.8158e1	-2.8158e1	-2.8144e1
-1.504e1	-1.4854e1	-1.4502e1	-1.4154e1	-1.3963e1	-1.407e1	-1.3978e1	-1.4316e1	-1.9829e1	-2.1154e1
-2.2702e1	-2.2668e1	-2.2585e1	-2.245e1	-2.2294e1	-2.3961e1	-2.2546e1	-2.2583e1	-2.2606e1	-2.5691e1
-2.6035e1	-2.6346e1	-2.6611e1	-2.6824e1	-2.6984e1	-2.7099e1	-2.7176e1	-2.7222e1	-2.7245e1	-2.7252e1
-1.4981e1	-1.4871e1	-1.4633e1	-1.4428e1	-1.4331e1	-1.4392e1	-1.4079e1	-1.5497e1	-1.9598e1	-2.093e1
-2.2579e1	-2.2549e1	-2.2486e1	-2.2392e1	-2.2282e1	-2.4182e1	-2.4018e1	-2.4044e1	-2.2555e1	-2.257e1
-2.5875e1	-2.6145e1	-2.6383e1	-2.6583e1	-2.6743e1	-2.6866e1	-2.6957e1	-2.7021e1	-2.7062e1	-2.7086e1
-1.5096e1	-1.4935e1	-1.4775e1	-1.4649e1	-1.4595e1	-1.4632e1	-1.5113e1	-1.5653e1	-1.9504e1	-2.0564e1
-2.1379e1	-2.2458e1	-2.2408e1	-2.234e1	-2.226e1	-2.3283e1	-2.4032e1	-2.4052e1	-2.4068e1	-2.2532e1
-2.5764e1	-2.5999e1	-2.6212e1	-2.6396e1	-2.655e1	-2.6675e1	-2.6773e1	-2.6847e1	-2.69e1	-2.6937e1
-1.5129e1	-1.501e1	-1.4901e1	-1.4821e1	-1.4788e1	-1.4812e1	-1.5349e1	-1.8582e1	-1.9483e1	-2.0323e1
-2.1014e1	-2.2386e1	-2.2347e1	-2.2295e1	-2.2235e1	-2.3295e1	-2.4257e1	-2.4063e1	-2.4076e1	-2.4086e1
-2.2513e1	-2.5893e1	-2.6083e1	-2.6251e1	-2.6397e1	-2.6519e1	-2.6618e1	-2.6697e1	-2.6759e1	-2.6805e1
-1.5172e1	-1.5084e1	-1.5008e1	-1.4954e1	-1.4932e1	-1.5786e1	-1.5535e1	-1.8795e1	-1.9499e1	-2.017e1
-2.0749e1	-2.1074e1	-2.2298e1	-2.2257e1	-2.221e1	-2.216e1	-2.4282e1	-2.428e1	-2.4084e1	-2.4092e1
-2.41e1	-2.5816e1	-2.5985e1	-2.6138e1	-2.6274e1	-2.6391e1	-2.6489e1	-2.657e1	-2.6636e1	-2.6687e1
-1.5217e1	-1.5151e1	-1.5096e1	-1.5058e1	-1.5857e1	-1.5993e1	-1.5678e1	-1.8972e1	-1.9532e1	-2.0074e1
-2.0559e1	-2.0963e1	-2.2257e1	-2.2225e1	-2.2187e1	-2.2147e1	-2.3298e1	-2.4299e1	-2.4092e1	-2.4099e1
-2.4105e1	-2.5761e1	-2.5912e1	-2.6051e1	-2.6176e1	-2.6286e1	-2.6381e1	-2.6462e1	-2.6529e1	-2.6585e1
-1.526e1	-1.521e1	-1.5169e1	-1.5142e1	-1.6033e1	-1.6156e1	-1.5789e1	-1.9117e1	-1.9571e1	-2.0015e1
-2.0423e1	-2.0776e1	-2.2223e1	-2.2197e1	-2.2166e1	-2.2133e1	-2.3302e1	-2.4316e1	-2.4312e1	-2.4106e1
-2.4111e1	-2.4115e1	-2.5856e1	-2.5982e1	-2.6097e1	-2.62e1	-2.6291e1	-2.637e1	-2.6438e1	-2.6495e1
-1.53e1	-1.5261e1	-1.523e1	-1.6101e1	-1.6175e1	-1.6286e1	-1.8882e1	-1.9238e1	-1.9612e1	-1.9981e1
-2.0326e1	-2.0633e1	-2.0895e1	-2.2173e1	-2.2147e1	-2.212e1	-2.2092e1	-2.433e1	-2.4325e1	-2.4113e1
-2.4116e1	-2.412e1	-2.5815e1	-2.5929e1	-2.6034e1	-2.613e1	-2.6217e1	-2.6293e1	-2.6359e1	-2.6416e1
-1.5336e1	-1.5306e1	-1.6176e1	-1.622e1	-1.6291e1	-1.639e1	-1.904e1	-1.9339e1	-1.9652e1	-1.9963e1
-2.0257e1	-2.0525e1	-2.076e1	-2.2152e1	-2.213e1	-2.2107e1	-2.2083e1	-2.33e1	-2.4337e1	-2.4333e1
-2.4122e1	-2.4125e1	-2.4128e1	-2.5887e1	-2.5984e1	-2.6073e1	-2.6154e1	-2.6227e1	-2.6291e1	-2.6348e1
-1.5369e1	-1.5345e1	-1.6274e1	-1.632e1	-1.6386e1	-1.6474e1	-1.9171e1	-1.9425e1	-1.969e1	-1.9955e1
-2.0208e1	-2.0443e1	-2.0652e1	-2.0696e1	-2.2115e1	-2.2095e1	-2.2075e1	-2.3302e1	-2.4347e1	-2.4343e1
-2.4127e1	-2.4129e1	-2.4132e1	-2.5855e1	-2.5943e1	-2.6026e1	-2.6102e1	-2.6171e1	-2.6233e1	-2.6288e1
-1.5398e1	-1.6328e1	-1.6358e1	-1.6403e1	-1.6465e1	-1.6543e1	-1.928e1	-1.9499e1	-1.9726e1	-1.9953e1
-2.0173e1	-2.0379e1	-2.0567e1	-2.0733e1	-2.2101e1	-2.2084e1	-2.2067e1	-2.3303e1	-2.4356e1	-2.4352e1
-2.4348e1	-2.4133e1	-2.4135e1	-2.4137e1	-2.5911e1	-2.5988e1	-2.6059e1	-2.6124e1	-2.6183e1	-2.6237e1

11 1. (10G11.4) -1 Vcont Layer - 1

9.7158e-3	9.7143e-3	9.7127e-3	9.7107e-3	9.7091e-3	9.7077e-3	9.4628e-3	9.4126e-3	9.3594e-3	8.1499e-3
8.073e-3	7.6982e-3	7.7111e-3	7.5242e-3	7.4663e-3	7.0869e-3	6.8168e-3	6.6499e-3	6.5748e-3	6.5494e-3
6.5461e-3	6.5512e-3	6.5194e-3	6.3871e-3	6.3918e-3	6.3958e-3	6.3989e-3	6.4016e-3	6.4034e-3	6.4053e-3
9.7122e-3	9.7106e-3	9.7081e-3	9.7059e-3	9.7034e-3	9.7019e-3	9.5064e-3	9.4524e-3	9.3571e-3	8.1514e-3
8.0547e-3	7.9943e-3	7.758e-3	7.8267e-3	7.7363e-3	8.0094e-4	7.491e-4	7.269e-4	7.2103e-4	7.2114e-4
7.229e-4	7.0807e-4	7.0905e-4	7.0981e-4	7.1037e-4	7.108e-4	7.1116e-4	7.1142e-4	7.1165e-4	7.1186e-4
9.7141e-3	9.7119e-3	9.7087e-3	9.7058e-3	9.7025e-3	9.7001e-3	9.5637e-3	9.5096e-3	9.3918e-3	8.4306e-3
8.0276e-3	7.9664e-3	7.7734e-3	7.8664e-3	7.8895e-3	7.9397e-4	7.2879e-4	7.1046e-4	7.1062e-4	7.0446e-4
7.0665e-4	7.0821e-4	7.0932e-4	7.1007e-4	7.1063e-4	7.1107e-4	7.1136e-4	7.1162e-4	7.1183e-4	7.1201e-4
9.9117e-3	9.7141e-3	9.7107e-3	9.7064e-3	9.7018e-3	9.6983e-3	9.6504e-3	9.5768e-3	9.4378e-3	8.3879e-3
7.9813e-3	7.9223e-3	7.7912e-3	7.7639e-3	7.4089e-3	6.7899e-3	7.1019e-4	6.974e-4	7.0043e-4	7.0457e-4
7.0728e-4	7.0888e-4	7.0987e-4	7.1057e-4	7.1104e-4	7.1139e-4	7.1165e-4	7.1186e-4	7.1312e-4	7.135e-4
9.9277e-3	9.9192e-3	9.7145e-3	9.7088e-3	9.7019e-3	9.6966e-3	9.6773e-3	9.6598e-3	9.485e-3	8.3253e-3
8.e-3	7.8683e-3	7.7956e-3	7.7314e-3	6.904e-3	6.4782e-3	7.0653e-4	7.001e-4	7.0365e-4	7.0717e-4
7.0905e-4	7.101e-4	7.1078e-4	7.1124e-4	7.1157e-4	7.118e-4	7.1297e-4	7.135e-4	7.1389e-4	7.1421e-4
1.0062e-2	9.9453e-3	9.9361e-3	9.908e-3	9.7053e-3	9.7095e-3	9.6933e-3	9.6657e-3	9.5803e-3	8.2687e-3
7.8782e-3	7.8354e-3	7.8159e-3	7.5949e-3	6.7549e-3	6.5767e-3	7.2879e-4	7.2363e-4	7.1333e-4	7.118e-4
7.116e-4	7.1171e-4	7.1186e-4	7.1204e-4	7.1215e-4	7.1362e-4	7.1415e-4	7.1454e-4	7.1483e-4	7.1504e-4
1.0079e-2	1.0069e-2	1.0055e-2	9.9729e-3	9.9312e-3	9.7457e-3	9.6455e-3	9.5719e-3	8.8891e-3	8.1049e-3
7.9161e-3	7.8594e-3	7.8328e-3	7.5444e-3	6.6555e-3	6.6523e-3	6.6319e-3	7.2898e-4	7.3393e-4	7.3624e-4
7.1392e-4	7.1327e-4	7.1295e-4	7.1409e-4	7.1474e-4	7.1522e-4	7.1554e-4	7.1575e-4	7.159e-4	7.1596e-4
1.0206e-2	1.0094e-2	1.0075e-2	1.0055e-2	1.0031e-2	9.9637e-3	8.8915e-3	8.7903e-3	8.7642e-3	8.6393e-3
8.0485e-3	8.0498e-3	8.0638e-3	7.4546e-3	6.6899e-3	6.6957e-3	6.736e-3	7.4178e-4	7.3905e-4	7.3867e-4
7.387e-4	7.3879e-4	7.4031e-4	7.2898e-4	7.2735e-4	7.2732e-4	7.2726e-4	7.272e-4	7.2713e-4	7.2704e-4
1.0233e-2	1.0202e-2	1.0145e-2	1.0055e-2	1.0109e-2	9.8546e-3	8.8776e-3	8.7568e-3	8.7283e-3	8.7717e-3
8.8848e-3	8.5449e-3	8.4788e-3	7.0066e-3	6.6501e-3	6.724e-3	6.8786e-3	7.5227e-4	7.4385e-4	7.4117e-4
7.4149e-4	7.4155e-4	7.4162e-4	7.4168e-4	7.4165e-4	7.3095e-4	7.3061e-4	7.287e-4	7.2839e-4	7.2811e-4
1.0277e-2	1.0272e-2	1.0269e-2	1.0212e-2	1.0096e-2	1.0044e-2	8.8453e-3	8.7615e-3	8.7567e-3	8.8139e-3
9.055e-3	9.1382e-3	8.2627e-3	7.1662e-3	6.6234e-3	6.5869e-3	6.6396e-3	6.6679e-3	7.3917e-4	7.4414e-4
7.4359e-4	7.4334e-4	7.4308e-4	7.4279e-4	7.4251e-4	7.4228e-4	7.4209e-4	7.4193e-4	7.3107e-4	7.3073e-4
1.0329e-2	1.035e-2	1.0401e-2	1.0438e-2	1.0279e-2	9.6811e-3	9.2071e-3	8.9218e-3	8.8032e-3	8.9455e-3
9.07e-3	9.1019e-3	8.5121e-3	7.1026e-3	6.6065e-3	6.563e-3	6.5531e-3	6.6481e-3	7.4239e-4	7.445e-4
7.4539e-4	7.4168e-4	7.4449e-4	7.4385e-4	7.4334e-4	7.4292e-4	7.426e-4	7.4235e-4	7.4216e-4	7.4197e-4
1.0642e-2	1.0633e-2	1.0623e-2	1.0668e-2	1.0503e-2	9.6159e-3	9.3062e-3	9.1147e-3	9.0209e-3	9.3594e-3
9.0602e-3	8.934e-3	8.1779e-3	7.205e-3	6.7145e-3	6.573e-3	6.6322e-3	6.5338e-3	7.4252e-4	7.4605e-4
7.4692e-4	7.463e-4	7.455e-4	7.4099e-4	7.3968e-4	7.4347e-4	7.4302e-4	7.427e-4	7.4244e-4	7.4222e-4
1.0809e-2	1.0672e-2	1.0698e-2	1.08e-2	1.069e-2	9.7067e-3	9.0869e-3	9.0455e-3	9.0547e-3	9.5812e-3
9.2532e-3	8.6139e-3	7.8158e-3	7.6638e-3	6.9715e-3	6.8165e-3	6.5927e-3	6.6792e-3	6.6268e-3	7.4766e-4
7.4808e-4	7.4692e-4	7.4576e-4	7.4492e-4	7.4434e-4	7.4239e-4	7.3841e-4	7.3778e-4	7.427e-4	7.4244e-4
1.1035e-2	1.1082e-2	1.1578e-2	1.1349e-2	1.0719e-2	1.0439e-2	9.487e-3	8.9194e-3	8.9907e-3	1.049e-2
9.9934e-3	8.8216e-3	8.152e-3	8.122e-3	8.4198e-3	8.6492e-3	8.1002e-3	6.9076e-3	6.787e-3	7.5016e-4
7.455e-4	7.4656e-4	7.4557e-4	7.4479e-4	7.4421e-4	7.438e-4	7.4348e-4	7.4152e-4	7.3747e-4	7.3703e-4
1.1281e-2	1.1271e-2	1.1675e-2	1.1477e-2	1.126e-2	1.0322e-2	9.5265e-3	9.2365e-3	1.0809e-2	1.2352e-2
1.1398e-2	1.0327e-2	8.7352e-3	9.1218e-3	9.4579e-3	9.2543e-3	9.1688e-3	8.4031e-3	7.6384e-3	8.0586e-4
7.9103e-4	7.9499e-4	7.6234e-4	7.4441e-4	7.4396e-4	7.4361e-4	7.4332e-4	7.4309e-4	7.4292e-4	7.4095e-4
1.0939e-2	1.0734e-2	1.0399e-2	9.7597e-3	9.9566e-3	9.9471e-3	1.0928e-2	1.1474e-2	1.189e-2	1.1919e-2
1.1136e-2	1.1071e-2	9.1775e-3	9.301e-3	9.6708e-3	9.537e-3	9.463e-3	8.7013e-3	8.2172e-3	7.8145e-3
8.2957e-4	8.2383e-4	8.2635e-4	8.3192e-4	8.4267e-4	8.4863e-4	8.6356e-4	7.7834e-4	7.4277e-4	7.4263e-4
1.0167e-2	9.9667e-3	9.5368e-3	8.8446e-3	9.1962e-3	1.0242e-2	1.1237e-2	1.1872e-2	1.1903e-2	1.0779e-2
1.0179e-2	1.2092e-2	1.1384e-2	9.4117e-3	9.5805e-3	9.5197e-3	9.4615e-3	9.0255e-3	8.6566e-3	8.1701e-3
8.8322e-4	8.7103e-4	8.4788e-4	8.4817e-4	8.5043e-4	8.5341e-4	8.6205e-4	8.7555e-4	8.7867e-4	8.8145e-4
1.0469e-2	1.0314e-2	1.0006e-2	9.6361e-3	1.0129e-2	1.1115e-2	1.2112e-2	1.1785e-2	1.1454e-2	1.0343e-2
9.3864e-3	9.437e-3	1.0675e-2	1.0716e-2	9.3941e-3	9.4004e-3	9.3779e-3	9.354e-3	8.7675e-3	8.511e-3
8.3078e-3	8.9646e-4	8.8955e-4	8.8686e-4	8.6274e-4	8.6321e-4	8.6441e-4	8.6587e-4	8.7369e-4	8.8665e-4
1.0753e-2	1.0809e-2	1.0969e-2	1.1517e-2	1.2049e-2	1.2079e-2	1.2343e-2	1.2131e-2	1.0953e-2	1.0201e-2
9.7807e-3	9.9722e-3	1.0226e-2	1.0416e-2	1.0213e-2	9.6054e-3	9.6411e-3	9.6289e-3	8.8929e-3	8.6959e-3
8.5201e-3	9.3286e-4	9.2381e-4	9.1888e-4	8.996e-4	8.9909e-4	8.9965e-4	8.7235e-4	8.7293e-4	8.7367e-4
1.1036e-2	1.1252e-2	1.1782e-2	1.2328e-2	1.22e-2	1.2647e-2	1.2545e-2	1.2294e-2	1.0685e-2	1.0018e-2
1.0017e-2	1.0133e-2	1.02e-2	1.0302e-2	1.0266e-2	1.0163e-2	9.6632e-3	9.6444e-3	9.6323e-3	9.0073e-3
8.8502e-3	8.723e-3	9.5849e-4	9.3209e-4	9.2855e-4	9.2733e-4	9.0753e-4	9.0753e-4	9.0801e-4	8.7824e-4
1.1235e-2	1.1677e-2	1.1964e-2	1.2424e-2	1.2728e-2	1.2585e-2	1.2595e-2	1.2402e-2	1.1811e-2	1.0065e-2
1.0151e-2	1.0154e-2	1.0227e-2	1.0293e-2	1.0005e-2	1.0204e-2	1.0231e-2	9.6586e-3	9.6432e-3	9.0886e-3
8.9562e-3	8.8431e-3	8.7535e-3	8.6824e-3	9.5993e-4	9.5682e-4	9.5561e-4	9.3393e-4	9.1333e-4	9.1346e-4
1.158e-2	1.171e-2	1.1948e-2	1.2264e-2	1.2402e-2	1.2357e-2	1.2583e-2	1.245e-2	1.069e-2	1.046e-2
1.0207e-2	1.0191e-2	1.0224e-2	1.0269e-2	1.032e-2	9.7202e-3	1.0259e-2	1.0242e-2	1.0232e-2	9.1431e-3
9.0303e-3	8.9307e-3	8.8477e-3	8.782e-3	8.7279e-3	9.661e-4	9.6354e-4	9.6251e-4	9.6175e-4	9.6152e-4

1.162e-2	1.1704e-2	1.1968e-2	1.2106e-2	1.2183e-2	1.2168e-2	1.2541e-2	1.2113e-2	1.0758e-2	1.0409e-2
1.0249e-2	1.0226e-2	1.0289e-2	1.0323e-2	1.0362e-2	9.6503e-3	9.7457e-3	9.7348e-3	1.0252e-2	1.0245e-2
9.0827e-3	8.995e-3	8.9192e-3	8.8565e-3	8.8069e-3	8.7693e-3	9.7086e-4	9.6921e-4	9.6784e-4	9.6703e-4
1.1562e-2	1.1666e-2	1.1898e-2	1.1985e-2	1.2034e-2	1.2033e-2	1.2234e-2	1.2064e-2	1.0785e-2	1.0501e-2
1.0302e-2	1.0294e-2	1.0314e-2	1.0339e-2	1.0368e-2	9.9348e-3	9.741e-3	9.7325e-3	9.7257e-3	1.026e-2
9.1194e-3	9.0423e-3	8.9737e-3	8.9152e-3	8.8669e-3	8.828e-3	9.771e-4	9.7509e-4	9.7329e-4	9.7204e-4
1.1545e-2	1.1765e-2	1.1837e-2	1.1895e-2	1.193e-2	1.1934e-2	1.2158e-2	1.1042e-2	1.079e-2	1.0568e-2
1.0394e-2	1.0325e-2	1.034e-2	1.036e-2	1.0382e-2	9.9693e-3	9.6608e-3	9.7288e-3	9.7232e-3	9.7189e-3
1.0266e-2	9.077e-3	9.0152e-3	8.9613e-3	8.9149e-3	8.8766e-3	9.8242e-4	9.797e-4	9.7759e-4	9.7601e-4
1.152e-2	1.1734e-2	1.1786e-2	1.1828e-2	1.1854e-2	1.1605e-2	1.2099e-2	1.098e-2	1.0784e-2	1.0605e-2
1.0457e-2	1.0652e-2	1.0357e-2	1.0372e-2	1.039e-2	1.0408e-2	9.652e-3	9.6516e-3	9.7206e-3	9.7171e-3
9.7137e-3	9.1024e-3	9.047e-3	8.9976e-3	8.954e-3	8.9169e-3	9.869e-4	9.8408e-4	8.8346e-3	8.8243e-3
1.1662e-2	1.1706e-2	1.1745e-2	1.1777e-2	1.1548e-2	1.1525e-2	1.2054e-2	1.0928e-2	1.0773e-2	1.0628e-2
1.0502e-2	1.04e-2	1.0371e-2	1.0383e-2	1.0397e-2	1.0412e-2	9.9643e-3	9.6451e-3	9.7179e-3	9.7148e-3
9.7122e-3	9.1206e-3	9.0709e-3	9.0257e-3	8.9853e-3	8.9502e-3	8.9201e-3	8.8945e-3	8.8735e-3	8.856e-3
1.1647e-2	1.1681e-2	1.1711e-2	1.1736e-2	1.1483e-2	1.1463e-2	1.2019e-2	1.0886e-2	1.0761e-2	1.0642e-2
1.0535e-2	1.0445e-2	1.0383e-2	1.0393e-2	1.0404e-2	1.0417e-2	9.9622e-3	9.6391e-3	9.6399e-3	9.7124e-3
9.7102e-3	9.7083e-3	9.0893e-3	9.0481e-3	9.0108e-3	8.9777e-3	8.9486e-3	8.9235e-3	8.9021e-3	8.8842e-3
1.1632e-2	1.1659e-2	1.1684e-2	1.1437e-2	1.1431e-2	1.1413e-2	1.095e-2	1.085e-2	1.0748e-2	1.0649e-2
1.0558e-2	1.0479e-2	1.0412e-2	1.0401e-2	1.0411e-2	1.0421e-2	1.0431e-2	9.6341e-3	9.6353e-3	9.71e-3
9.7085e-3	9.7067e-3	9.1028e-3	9.0654e-3	9.0312e-3	9.0002e-3	8.9722e-3	8.948e-3	8.927e-3	8.909e-3
1.1618e-2	1.1641e-2	1.1393e-2	1.1396e-2	1.1389e-2	1.1374e-2	1.0904e-2	1.0821e-2	1.0736e-2	1.0652e-2
1.0574e-2	1.0505e-2	1.0444e-2	1.0408e-2	1.0417e-2	1.0425e-2	1.0434e-2	9.9608e-3	9.6311e-3	9.632e-3
9.7065e-3	9.7051e-3	9.7037e-3	9.0792e-3	9.0474e-3	9.0186e-3	8.9925e-3	8.9691e-3	8.9486e-3	8.9305e-3
1.1606e-2	1.1624e-2	1.1361e-2	1.1361e-2	1.1355e-2	1.1342e-2	1.0866e-2	1.0796e-2	1.0724e-2	1.0653e-2
1.0586e-2	1.0524e-2	1.047e-2	1.0776e-2	1.0422e-2	1.0429e-2	1.0437e-2	9.9597e-3	9.6276e-3	9.6286e-3
9.7047e-3	9.7037e-3	9.7023e-3	9.0897e-3	9.0608e-3	9.0338e-3	9.0092e-3	8.987e-3	8.9671e-3	8.9496e-3
1.1595e-2	1.133e-2	1.1334e-2	1.1333e-2	1.1327e-2	1.1315e-2	1.0835e-2	1.0774e-2	1.0713e-2	1.0652e-2
1.0593e-2	1.0539e-2	1.049e-2	1.0447e-2	1.0427e-2	1.0433e-2	1.044e-2	9.9589e-3	9.6243e-3	9.6254e-3
9.6265e-3	9.7023e-3	9.7014e-3	9.7005e-3	9.0713e-3	9.0462e-3	9.0231e-3	9.0021e-3	8.9832e-3	8.9659e-3

11 1. (10G11.4) -1 Aquifer Top - 1

-3.7554	-3.7719	-3.7902	-3.809	-3.8263	-3.84	-4.5124	-4.6388	-4.4027	-7.8228
-7.931	-8.404	-8.0567	-7.8046	-7.7904	-8.5411	-9.1058	-9.4691	-9.6702	-9.7985
-9.8935	-9.967	-1.0144e1	-1.0993e1	-1.1049e1	-1.1095e1	-1.1132e1	-1.1163e1	-1.1187e1	-1.1208e1
-3.7458	-3.7651	-3.7882	-3.8126	-3.8356	-3.8532	-4.3925	-4.5278	-4.77	-7.9048
-8.0913	-8.0201	-7.9406	-7.3032	-7.198	-8.2319	-9.1737	-9.5743	-9.7427	-9.8604
-9.9567	-1.082e1	-1.0925e1	-1.1005e1	-1.1065e1	-1.1112e1	-1.1149e1	-1.1178e1	-1.1202e1	-1.1222e1
-3.7298	-3.7522	-3.7811	-3.8135	-3.8452	-3.8692	-4.2515	-4.385	-4.6806	-7.4581
-8.3593	-8.344	-8.1196	-7.1645	-6.8861	-8.3475	-9.4471	-9.6812	-9.7898	-1.0438e1
-1.067e1	-1.0837e1	-1.0953e1	-1.1035e1	-1.1094e1	-1.1139e1	-1.1173e1	-1.12e1	-1.1221e1	-1.1239e1
-3.2227	-3.7288	-3.7633	-3.8075	-3.853	-3.8874	-4.0529	-4.2189	-4.5643	-7.5981
-8.7287	-8.8513	-8.9047	-8.0159	-8.003	-9.2437	-9.712	-9.6629	-1.0011e1	-1.0452e1
-1.0736e1	-1.0907e1	-1.1015e1	-1.1088e1	-1.1138e1	-1.1176e1	-1.1204e1	-1.1226e1	-1.1265e1	-1.1288e1
-3.1748	-3.1995	-3.7245	-3.7832	-3.8522	-3.9047	-3.9807	-4.0276	-4.4464	-7.8055
-8.9376	-9.3208	-9.4113	-9.2134	-1.0084e1	-1.081e1	-1.0622e1	-9.9923	-1.0354e1	-1.0723e1
-1.0924e1	-1.1039e1	-1.1111e1	-1.116e1	-1.1195e1	-1.1221e1	-1.1259e1	-1.1288e1	-1.131e1	-1.1328e1
-2.7058	-3.1223	-3.1489	-3.2318	-3.8177	-3.902	-3.9373	-4.0115	-4.2256	-7.9964
-9.3886	-9.5408	-9.5412	-9.9362	-1.1715e1	-1.1887e1	-1.1963e1	-1.1899e1	-1.1341e1	-1.1209e1
-1.1197e1	-1.1212e1	-1.1229e1	-1.1246e1	-1.126e1	-1.1302e1	-1.1327e1	-1.1346e1	-1.1361e1	-1.1372e1
-2.652	-2.6918	-2.7464	-3.0392	-3.1673	-3.8243	-4.0658	-4.2667	-6.3401	-8.5844
-9.2512	-9.4893	-9.5601	-1.0018e1	-1.2142e1	-1.204e1	-1.2257e1	-1.22e1	-1.2221e1	-1.2233e1
-1.145e1	-1.1381e1	-1.1348e1	-1.136e1	-1.1377e1	-1.1392e1	-1.1402e1	-1.141e1	-1.1415e1	-1.1419e1
-1.7514	-2.6217	-2.6967	-2.7744	-2.8945	-3.0981	-6.3541	-6.7047	-6.784	-7.1413
-8.7865	-9.1635	-9.139	-1.0167e1	-1.1958e1	-1.219e1	-1.2356e1	-1.2336e1	-1.2281e1	-1.2262e1
-1.2254e1	-1.225e1	-1.2273e1	-1.2087e1	-1.1405e1	-1.14e1	-1.1395e1	-1.139e1	-1.1385e1	-1.1379e1
-1.5858	-1.8492	-2.2346	-2.7032	-2.7797	-3.4652	-6.4686	-6.858	-6.9029	-6.9232
-7.0078	-8.3411	-8.4462	-1.0106e1	-1.0842e1	-1.1305e1	-1.2567e1	-1.2457e1	-1.2333e1	-1.229e1
-1.2295e1	-1.2297e1	-1.2298e1	-1.2298e1	-1.2296e1	-1.2129e1	-1.2116e1	-1.1465e1	-1.1448e1	-1.1433e1
-1.2915	-1.4674	-1.678	-2.0209	-2.6511	-2.7612	-6.4788	-6.8036	-6.9004	-6.9506
-7.2335	-7.3218	-8.2474	-9.5225	-1.0347e1	-1.0539e1	-1.1175e1	-1.1574e1	-1.1657e1	-1.2337e1
-1.2336e1	-1.2334e1	-1.2329e1	-1.2322e1	-1.2314e1	-1.2308e1	-1.2303e1	-1.2298e1	-1.2127e1	-1.2117e1
-8.8055e-1	-9.3424e-1	-1.1162	-1.2719	-1.1084	-2.6236	-4.9486	-5.9995	-6.5852	-7.1402
-7.3949	-7.4479	-7.7189	-9.2061	-1.0185e1	-1.0401e1	-1.0602e1	-1.108e1	-1.1446e1	-1.1758e1
-1.1915e1	-1.2368e1	-1.2362e1	-1.2346e1	-1.2333e1	-1.2322e1	-1.2314e1	-1.2307e1	-1.2301e1	-1.2296e1
4.2383e-1	4.4794e-1	5.5847e-1	1.4784	1.3131	-3.0059	-4.5374	-5.0241	-5.4574	-6.6271
-7.3052	-7.5647	-7.5273	-8.1865	-9.2906	-1.0002e1	-1.0245e1	-1.0725e1	-1.1633e1	-1.2114e1
-1.2239e1	-1.2126e1	-1.1981e1	-1.2353e1	-1.2338e1	-1.2335e1	-1.2323e1	-1.2314e1	-1.2307e1	-1.2301e1
3.1141e-1	6.5203e-1	1.07	2.6114	3.2564	-2.9761	-4.8627	-5.2706	-6.1637	-6.4536
-6.8343	-7.058	-7.0054	-6.9946	-8.0085	-8.9453	-9.7305	-1.054e1	-1.1625e1	-1.2378e1
-1.2437e1	-1.2248e1	-1.2053e1	-1.1907e1	-1.1802e1	-1.1954e1	-1.2315e1	-1.2308e1	-1.2313e1	-1.2306e1
-2.6503e-3	-1.2434e-2	-9.3407e-1	-1.5144	-1.1112	-4.4104	-4.9377	-6.0691	-6.5625	-5.8569
-6.3262	-7.748	-7.7149	-7.4655	-7.0077	-7.1807	-8.458	-1.0482e1	-1.1235e1	-1.2048e1
-1.2279e1	-1.2204e1	-1.2039e1	-1.1905e1	-1.1803e1	-1.1728e1	-1.167e1	-1.1884e1	-1.2298e1	-1.2294e1
-1.451	-1.5172	-2.1232	-2.0607	-2.1058	-3.3034	-5.1344	-5.9236	-5.7243	-5.1576
-5.663	-7.289	-9.1829	-8.9083	-8.4072	-8.0223	-7.9717	-8.9201	-1.0256e1	-1.1115e1
-1.1439e1	-1.1345e1	-1.1563e1	-1.1861e1	-1.1779e1	-1.1713e1	-1.1661e1	-1.1619e1	-1.1586e1	-1.1837e1
-1.6499	-1.8203	-2.1145	-2.7827	-2.7489	-3.3088	-3.6824	-3.3514	-3.6752	-4.4333
-6.1756	-6.4638	-8.8259	-8.641	-8.0975	-8.2918	-8.3983	-8.6635	-9.3445	-1.003e1
-1.0668e1	-1.0764e1	-1.0698e1	-1.0574e1	-1.0555e1	-1.0439e1	-1.0639e1	-1.1277e1	-1.1576e1	-1.1551e1
-2.2411	-2.3426	-2.5222	-2.6589	-2.5952	-2.7573	-3.0264	-2.8184	-2.8634	-4.8037
-7.4196	-5.5105	-6.1002	-8.4757	-8.2318	-8.3171	-8.4006	-8.8536	-9.3111	-9.4444
-9.7984	-9.9775	-1.031e1	-1.0285e1	-1.0227e1	-1.0159e1	-1.0222e1	-1.0471e1	-1.0433e1	-1.0398e1
-2.2327	-2.2338	-2.2872	-2.3513	-2.1273	-2.1232	-2.3878	-2.9632	-3.5341	-5.6989
-8.4513	-8.3772	-6.8674	-6.8098	-8.4161	-8.4063	-8.4393	-8.4746	-9.1145	-9.4479
-9.7263	-9.5769	-9.6706	-9.6948	-1.0023e1	-9.9979	-9.9626	-9.9243	-1.0028e1	-1.0324e1
-2.0571	-1.9846	-1.8685	-1.6015	-1.4659	-1.6003	-1.9872	-2.3603	-4.4462	-6.0122
-7.9554	-7.7746	-7.5096	-7.2309	-7.4296	-8.1628	-8.1817	-8.1963	-9.0206	-9.2664
-9.4875	-9.6573	-9.7698	-9.8324	-9.4867	-9.4797	-9.4576	-9.8237	-9.8018	-9.7786
-1.9193	-1.7945	-1.52	-1.3552	-1.5183	-1.2971	-1.6695	-2.061	-4.979	-6.906
-7.6648	-7.6308	-7.6042	-7.4034	-7.3942	-7.4332	-8.1645	-8.1842	-8.198	-8.8395
-9.0301	-9.1897	-9.309	-9.6691	-9.7133	-9.735	-9.3435	-9.3315	-9.3135	-9.7104
-1.8324	-1.5658	-1.4735	-1.3743	-1.242	-1.336	-1.5856	-1.8873	-3.2908	-6.8929
-7.5523	-7.5515	-7.5131	-7.4052	-7.6794	-7.3963	-7.4172	-8.1728	-8.1892	-8.745
-8.902	-9.0399	-9.1519	-9.2354	-9.293	-9.3294	-9.3494	-9.6557	-9.2385	-9.227
-1.611	-1.5746	-1.4864	-1.4746	-1.4245	-1.4853	-1.6198	-1.8261	-5.2821	-6.2945
-7.4753	-7.47	-7.436	-7.3706	-7.2928	-8.0413	-7.3883	-7.4007	-7.4082	-8.683
-8.8145	-8.9335	-9.035	-9.1166	-9.1778	-9.2219	-9.2514	-9.2691	-9.2779	-9.2806
-1.599	-1.5842	-1.6399	-1.5831	-1.5666	-1.6123	-1.68	-2.659	-5.1427	-5.9981
-7.4154	-7.4071	-7.3807	-7.3368	-7.2836	-8.1323	-8.0617	-8.0698	-7.3866	-7.3913
-8.7538	-8.8569	-8.948	-9.0245	-9.0857	-9.1328	-9.1677	-9.1922	-9.2079	-9.2171
-1.6469	-1.6053	-1.7053	-1.6747	-1.6729	-1.7086	-2.4021	-2.7627	-5.0848	-5.7635
-6.2929	-7.3604	-7.3393	-7.3081	-7.2702	-7.6931	-8.068	-8.074	-8.0789	-7.3751
-8.7117	-8.8014	-8.8828	-8.9531	-9.012	-9.0598	-9.0974	-9.1257	-9.146	-9.1601
-1.6591	-1.7921	-1.7638	-1.7485	-1.753	-1.7817	-2.5586	-4.4989	-5.0706	-5.6073
-6.0525	-7.3243	-7.3077	-7.2842	-7.2561	-7.6963	-8.1602	-8.079	-8.0828	-8.0857
-7.3656	-8.7611	-8.8336	-8.8978	-8.9536	-9.0002	-9.0381	-9.0683	-9.0921	-9.1096
-1.6735	-1.8313	-1.8141	-1.807	-1.814	-2.3859	-2.682	-4.632	-5.0787	-5.5066
-5.8778	-6.4757	-7.2828	-7.2644	-7.2427	-7.2192	-8.1705	-8.1679	-8.0865	-8.0887
-8.0911	-8.7319	-8.7963	-8.8548	-8.9067	-8.9514	-8.9889	-9.0198	-9.045	-9.0645
-1.8828	-1.8665	-1.856	-1.8537	-2.3914	-2.4999	-2.777	-4.7418	-5.0972	-5.4424

-5.7522	-6.0107	-7.2622	-7.2479	-7.2305	-7.2119	-7.6915	-8.1759	-8.0901	-8.0919
-8.0936	-8.711	-8.7686	-8.8216	-8.8693	-8.9113	-8.9476	-8.9786	-9.0042	-9.0256
-1.9082	-1.8973	-1.8912	-1.8918	-2.4907	-2.5898	-2.8508	-4.8316	-5.1197	-5.4022
-5.6621	-5.8871	-7.2454	-7.2338	-7.2197	-7.2044	-7.6922	-8.1829	-8.1802	-8.095
-8.0963	-8.0973	-8.7473	-8.7954	-8.8392	-8.8785	-8.9132	-8.9434	-8.9694	-8.9912
-1.9313	-1.9239	-1.9208	-2.5042	-2.5714	-2.6612	-4.6803	-4.9061	-5.1434	-5.3779
-5.5974	-5.7928	-5.959	-7.2217	-7.21	-7.1976	-7.1845	-8.1886	-8.1856	-8.098
-8.0986	-8.0996	-8.7317	-8.7752	-8.8152	-8.8518	-8.885	-8.914	-8.9392	-8.961
-1.9519	-1.9474	-2.5272	-2.574	-2.6373	-2.718	-4.7786	-4.9682	-5.1667	-5.364
-5.551	-5.7211	-5.87	-7.2112	-7.2014	-7.1909	-7.1798	-7.688	-8.1905	-8.1881
-8.1012	-8.1019	-8.1026	-8.7592	-8.7961	-8.8301	-8.861	-8.8889	-8.9133	-8.935
-1.9704	-1.9676	-2.5866	-2.6326	-2.6912	-2.7634	-4.8597	-5.0208	-5.1889	-5.3568
-5.5175	-5.6665	-5.799	-6.2646	-7.1938	-7.1847	-7.1755	-7.6882	-8.1946	-8.1923
-8.1033	-8.1037	-8.1044	-8.747	-8.7805	-8.8122	-8.8412	-8.8675	-8.8911	-8.9121
-1.9866	-2.6033	-2.6375	-2.6813	-2.7357	-2.8003	-4.9271	-5.0659	-5.2098	-5.3539
-5.4933	-5.6239	-5.7427	-5.8476	-7.1869	-7.1791	-7.1713	-7.688	-8.1982	-8.196
-8.1938	-8.1054	-8.1058	-8.1063	-8.7683	-8.7977	-8.8248	-8.8495	-8.8721	-8.8927
11	1. (10G11.4)			-1 Conductivity Layer - 2					
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	2.592e3	2.592e3
2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	7.344e2	1.728e2	1.728e2	1.728e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	2.592e3	2.592e3
2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	7.344e2	7.344e2	7.344e2	7.344e2
1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	2.592e3	2.592e3
2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2	1.728e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	2.592e3	2.592e3
2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3
2.592e3	2.592e3	2.592e3	2.592e3	7.344e2	7.344e2	1.728e2	1.728e2	1.728e2	1.728e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	2.592e3
2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3
2.592e3	2.592e3	2.592e3	2.592e3	7.344e2	7.344e2	7.344e2	1.728e2	1.728e2	1.728e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3	2.592e3
2.592e3	2.592e3	2.592e3	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	1.728e2	1.728e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	1.728e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	8.64e1
8.64e1	8.64e1	7.344e2	8.64e1	1.296e1	1.296e1	1.296e1	1.296e1	1.296e1	1.296e1
1.296e1	1.296e1	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	8.64e1	8.64e1
8.64e1	8.64e1	8.64e1	8.64e1	8.64e1	1.296e1	7.344e2	7.344e2	7.344e2	7.344e2
8.64e1	1.296e1	1.296e1	1.296e1	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
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1.296e1	1.296e1	8.64e1	8.64e1	8.64e1	1.296e1	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	1.296e1	1.296e1	1.296e1	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	8.64e1	8.64e1	8.64e1	8.64e1	8.64e1
8.64e1	1.296e1	8.64e1	8.64e1	8.64e1	1.296e1	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	8.64e1	1.296e1	1.296e1	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	8.64e1
8.64e1	1.296e1	1.296e1	1.296e1	1.296e1	1.296e1	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	8.64e1	1.296e1	1.296e1	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	8.64e1
8.64e1	1.296e1	8.64e1	8.64e1	8.64e1	1.296e1	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	1.296e1	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	8.64e1
8.64e1	8.64e1	8.64e1	8.64e1	8.64e1	1.296e1	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	1.296e1	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	1.296e1	1.296e1	1.296e1	1.296e1
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
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7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	1.296e1	1.296e1	8.64e1	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
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7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2

7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2	7.344e2
11	1. (10G11.4)			-1 Aquifer Bottom - 2					
-4.1131e1	-4.1305e1	-4.15e1	-4.1698e1	-4.188e1	-4.2024e1	-4.2754e1	-4.2691e1	-4.1573e1	-3.9497e1
-3.8908e1	-3.8267e1	-3.7424e1	-3.711e1	-3.7234e1	-3.9352e1	-4.1254e1	-4.2497e1	-4.3108e1	-4.3378e1
-4.3493e1	-4.3539e1	-4.3263e1	-4.488e1	-4.488e1	-4.488e1	-4.488e1	-4.4879e1	-4.4878e1	-4.4878e1
-4.1028e1	-4.1235e1	-4.1478e1	-4.1736e1	-4.1977e1	-4.2164e1	-4.2815e1	-4.2747e1	-4.2624e1	-3.977e1
-3.9171e1	-3.8247e1	-3.7048e1	-3.5406e1	-3.5305e1	-3.8472e1	-4.1711e1	-4.3194e1	-4.366e1	-4.3772e1
-4.3779e1	-4.488e1	-4.4882e1	-4.4882e1	-4.4882e1	-4.4881e1	-4.488e1	-4.488e1	-4.4879e1	-4.4878e1
-4.0863e1	-4.1099e1	-4.1402e1	-4.1746e1	-4.2078e1	-4.2332e1	-4.2886e1	-4.2819e1	-4.2669e1	-4.1955e1
-3.9617e1	-3.8837e1	-3.7435e1	-3.4997e1	-3.4284e1	-3.888e1	-4.2972e1	-4.4145e1	-4.4244e1	-4.4868e1
-4.4879e1	-4.4883e1	-4.4885e1	-4.4884e1	-4.4883e1	-4.4882e1	-4.4881e1	-4.488e1	-4.4879e1	-4.4878e1
-3.7224e1	-4.085e1	-4.1216e1	-4.1683e1	-4.2162e1	-4.2523e1	-4.3149e1	-4.2903e1	-4.2728e1	-4.1868e1
-4.0119e1	-3.9751e1	-3.8997e1	-3.7212e1	-3.7559e1	-4.1529e1	-4.4191e1	-4.4805e1	-4.4846e1	-4.4876e1
-4.4887e1	-4.4889e1	-4.4888e1	-4.4887e1	-4.4885e1	-4.4883e1	-4.4882e1	-4.488e1	-4.5009e1	-4.5018e1
-3.673e1	-3.6982e1	-4.0807e1	-4.1426e1	-4.2153e1	-4.2707e1	-4.3085e1	-4.3127e1	-4.2788e1	-4.174e1
-4.1041e1	-4.0432e1	-4.0258e1	-3.9667e1	-4.1374e1	-4.5037e1	-4.4905e1	-4.4865e1	-4.4891e1	-4.4904e1
-4.4902e1	-4.4897e1	-4.4892e1	-4.4889e1	-4.4886e1	-4.4884e1	-4.5006e1	-4.502e1	-4.503e1	-4.5039e1
-3.4233e1	-3.6191e1	-3.6461e1	-3.7311e1	-4.179e1	-4.2786e1	-4.3046e1	-4.3112e1	-4.2312e1	-4.1622e1
-4.0648e1	-4.0641e1	-4.0613e1	-4.1487e1	-4.4077e1	-4.4806e1	-4.4969e1	-4.5229e1	-4.5021e1	-4.4944e1
-4.4916e1	-4.4903e1	-4.4895e1	-4.489e1	-4.4886e1	-4.5022e1	-4.5038e1	-4.5049e1	-4.5057e1	-4.5062e1
-3.391e1	-3.3871e1	-3.3868e1	-3.5332e1	-3.6663e1	-4.2208e1	-4.3161e1	-4.3341e1	-4.3016e1	-4.0569e1
-4.0634e1	-4.0601e1	-4.0789e1	-4.1666e1	-4.4886e1	-4.4781e1	-4.4862e1	-4.5152e1	-4.5076e1	-4.5062e1
-4.4916e1	-4.4902e1	-4.4894e1	-4.5026e1	-4.505e1	-4.5067e1	-4.5078e1	-4.5085e1	-4.5088e1	-4.509e1
-3.3634e1	-3.3515e1	-3.3381e1	-3.3241e1	-3.3891e1	-3.6002e1	-4.3091e1	-4.3095e1	-4.2978e1	-4.2726e1
-4.0585e1	-4.0571e1	-4.0561e1	-4.1995e1	-4.4953e1	-4.4969e1	-4.5152e1	-4.5067e1	-4.5079e1	-4.5079e1
-4.5073e1	-4.5067e1	-4.5236e1	-4.54e1	-4.5603e1	-4.5603e1	-4.5602e1	-4.5601e1	-4.5598e1	-4.5596e1
-3.2834e1	-3.283e1	-3.3063e1	-3.297e1	-3.3193e1	-3.515e1	-4.2209e1	-4.3319e1	-4.2715e1	-4.2796e1
-4.2347e1	-4.044e1	-4.0426e1	-4.4654e1	-4.5457e1	-4.5582e1	-4.5888e1	-4.5455e1	-4.5187e1	-4.5118e1
-4.526e1	-4.5313e1	-4.5344e1	-4.5355e1	-4.5355e1	-4.5476e1	-4.5467e1	-4.5641e1	-4.5632e1	-4.5624e1
-3.2787e1	-3.2722e1	-3.2636e1	-3.2906e1	-3.3244e1	-3.3844e1	-4.2658e1	-4.3034e1	-4.2957e1	-4.2664e1
-4.0786e1	-4.0593e1	-4.1714e1	-4.386e1	-4.5356e1	-4.5485e1	-4.5512e1	-4.5478e1	-4.5366e1	-4.5389e1
-4.5463e1	-4.5497e1	-4.5492e1	-4.5469e1	-4.5441e1	-4.5415e1	-4.5392e1	-4.5371e1	-4.5482e1	-4.5469e1
-3.2764e1	-3.2642e1	-3.2353e1	-3.215e1	-3.3826e1	-3.7244e1	-4.0282e1	-4.246e1	-4.2663e1	-4.1012e1
-4.0282e1	-4.0354e1	-4.1063e1	-4.3735e1	-4.5333e1	-4.546e1	-4.5457e1	-4.569e1	-4.5828e1	-4.5957e1
-4.6023e1	-4.5831e1	-4.5669e1	-4.5595e1	-4.5532e1	-4.5483e1	-4.5444e1	-4.5412e1	-4.5387e1	-4.5366e1
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-3.9498e1	-3.9405e1	-4.1535e1	-4.3715e1	-4.479e1	-4.5362e1	-4.5388e1	-4.5713e1	-4.5917e1	-4.6113e1
-4.6164e1	-4.6116e1	-4.6054e1	-4.5802e1	-4.5727e1	-4.5543e1	-4.549e1	-4.5449e1	-4.5417e1	-4.5391e1
-3.2901e1	-3.3257e1	-3.315e1	-3.3197e1	-3.3781e1	-3.7853e1	-3.6501e1	-3.7627e1	-3.6522e1	-3.706e1
-3.9182e1	-4.0887e1	-4.3016e1	-4.3429e1	-4.4623e1	-4.5043e1	-4.5304e1	-4.5512e1	-4.6014e1	-4.6223e1
-4.6248e1	-4.6168e1	-4.6086e1	-4.6025e1	-4.598e1	-4.5982e1	-4.5655e1	-4.5617e1	-4.5442e1	-4.5412e1
-3.304e1	-3.2892e1	-3.2605e1	-3.2175e1	-2.936e1	-3.7511e1	-3.7111e1	-3.5178e1	-3.6255e1	-3.687e1
-3.7927e1	-4.1445e1	-4.3235e1	-4.3295e1	-4.2402e1	-4.2222e1	-4.3079e1	-4.448e1	-4.5286e1	-4.5931e1
-4.6207e1	-4.6151e1	-4.6082e1	-4.6025e1	-4.5982e1	-4.595e1	-4.5926e1	-4.5946e1	-4.5601e1	-4.5575e1
-3.325e1	-3.3171e1	-3.294e1	-3.2685e1	-3.2163e1	-3.4885e1	-3.5073e1	-3.4247e1	-3.5723e1	-3.7467e1
-3.7881e1	-3.9884e1	-4.277e1	-4.2188e1	-4.193e1	-4.1899e1	-4.1924e1	-4.2992e1	-4.4262e1	-4.5041e1
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-3.3523e1	-3.2717e1	-3.3209e1	-3.3722e1	-3.4021e1	-3.3374e1	-3.2631e1	-3.1834e1	-3.2282e1	-3.4595e1
-3.6971e1	-3.8937e1	-4.171e1	-4.2146e1	-4.1582e1	-4.1816e1	-4.1892e1	-4.2635e1	-4.3328e1	-4.3994e1
-4.4618e1	-4.4711e1	-4.4655e1	-4.4545e1	-4.4428e1	-4.432e1	-4.4351e1	-4.4789e1	-4.5888e1	-4.5877e1
-3.2174e1	-3.264e1	-3.3635e1	-3.5138e1	-3.4482e1	-3.3456e1	-3.1652e1	-3.1116e1	-3.1233e1	-3.2727e1
-3.6558e1	-3.7505e1	-3.8007e1	-4.1977e1	-4.1776e1	-4.1833e1	-4.1892e1	-4.2453e1	-4.2928e1	-4.3409e1
-4.3764e1	-4.3945e1	-4.429e1	-4.4273e1	-4.4224e1	-4.4166e1	-4.4106e1	-4.4179e1	-4.4137e1	-4.41e1
-3.1661e1	-3.1926e1	-3.2561e1	-3.3415e1	-3.2048e1	-3.0416e1	-3.0543e1	-3.0838e1	-3.168e1	-3.3441e1
-3.5983e1	-3.5999e1	-3.5499e1	-3.988e1	-4.1908e1	-4.1897e1	-4.1917e1	-4.1939e1	-4.2719e1	-4.3067e1
-4.3358e1	-4.3552e1	-4.3653e1	-4.3685e1	-4.403e1	-4.4012e1	-4.3984e1	-4.3952e1	-4.392e1	-4.4026e1
-3.0896e1	-3.062e1	-3.0006e1	-2.7961e1	-2.6144e1	-2.7108e1	-2.9189e1	-3.0723e1	-3.2422e1	-3.3692e1
-3.4984e1	-3.3301e1	-3.2126e1	-3.3559e1	-3.7545e1	-3.9546e1	-3.9863e1	-3.9966e1	-4.2617e1	-4.2873e1
-4.3104e1	-4.3281e1	-4.3398e1	-4.3463e1	-4.3489e1	-4.349e1	-4.3475e1	-4.3856e1	-4.3839e1	-4.3821e1
-3.0118e1	-2.9352e1	-2.7286e1	-2.5064e1	-2.2788e1	-2.444e1	-2.7586e1	-3.0019e1	-3.2856e1	-3.2841e1
-3.3615e1	-3.1045e1	-3.0484e1	-3.2554e1	-3.6024e1	-3.7397e1	-3.9155e1	-3.9475e1	-3.9633e1	-4.0593e1
-4.0913e1	-4.1166e1	-4.1348e1	-4.3289e1	-4.3334e1	-4.3356e1	-4.3362e1	-4.3356e1	-4.3344e1	-4.3755e1
-2.8562e1	-2.7835e1	-2.6907e1	-2.5217e1	-2.4061e1	-2.5005e1	-2.7116e1	-2.8118e1	-2.904e1	-3.2518e1
-3.3416e1	-3.2313e1	-3.2038e1	-3.2801e1	-3.338e1	-3.672e1	-3.7457e1	-3.9044e1	-3.9301e1	-4.0204e1
-4.0529e1	-4.079e1	-4.0989e1	-4.1132e1	-4.1228e1	-4.1286e1	-4.1315e1	-4.327e1	-4.3269e1	-4.3263e1
-2.8269e1	-2.7991e1	-2.7142e1	-2.6236e1	-2.5789e1	-2.6289e1	-2.7421e1	-2.79e1	-3.0002e1	-3.0878e1
-3.3663e1	-3.3181e1	-3.3036e1	-3.33e1	-3.3702e1	-3.7287e1	-3.7097e1	-3.7533e1	-3.7814e1	-3.9889e1
-4.0216e1	-4.0481e1	-4.069e1	-4.085e1	-4.0967e1	-4.1049e1	-4.1102e1	-4.1134e1	-4.1149e1	-4.1153e1
-2.8209e1	-2.812e1	-2.7586e1	-2.7121e1	-2.6955e1	-2.7244e1	-2.7866e1	-2.7916e1	-2.9845e1	-3.0585e1
-3.392e1	-3.3674e1	-3.3589e1	-3.3691e1	-3.39e1	-3.5161e1	-3.7792e1	-3.8179e1	-3.7595e1	-3.7793e1
-3.9968e1	-4.0231e1	-4.0443e1	-4.0612e1	-4.0742e1	-4.084e1	-4.0911e1	-4.096e1	-4.0993e1	-4.1012e1
-2.8662e1	-2.8333e1	-2.8004e1	-2.7759e1	-2.7701e1	-2.7882e1	-2.7464e1	-2.801e1	-2.9785e1	-3.0392e1
-3.1754e1	-3.398e1	-3.3924e1	-3.3967e1	-3.4081e1	-3.3987e1	-3.7757e1	-3.8081e1	-3.8335e1	-3.7642e1
-3.9776e1	-4.0031e1	-4.0242e1	-4.0413e1	-4.0551e1	-4.0658e1	-4.0741e1	-4.0804e1	-4.0849e1	-4.0881e1
-2.8779e1	-2.8552e1	-2.8347e1	-2.8212e1	-2.8196e1	-2.8318e1	-2.773e1	-2.9186e1	-2.9777e1	-3.0269e1
-3.164e1	-3.4184e1	-3.4146e1	-3.4165e1	-3.423e1	-3.4066e1	-3.5522e1	-3.8044e1	-3.8265e1	-3.8443e1
-3.7679e1	-3.9875e1	-4.0079e1	-4.0249e1	-4.0389e1	-4.0502e1	-4.0593e1	-4.0664e1	-4.0719e1	-4.0761e1
-2.8905e1	-2.8748e1	-2.8617e1	-2.8541e1	-2.8541e1	-2.8259e1	-2.7931e1	-2.934e1	-2.9795e1	-3.0194e1
-3.1555e1	-3.1787e1	-3.4302e1	-3.431e1	-3.4349e1	-3.441e1	-3.5555e1	-3.5716e1	-3.823e1	-3.8389e1
-3.8521e1	-3.9756e1	-3.9949e1	-4.0114e1	-4.0253e1	-4.0369e1	-4.0463e1	-4.0541e1	-4.0602e1	-4.0651e1
-2.9026e1	-2.8916e1	-2.883e1	-2.8785e1	-2.8414e1	-2.8478e1	-2.8084e1	-2.9466e1	-2.9825e1	-3.015e1
-3.1495e1	-3.1714e1	-3.4418e1	-3.442e1	-3.4445e1	-3.4486e1	-3.4273e1	-3.5726e1	-3.822e1	-3.8359e1
-3.8479e1	-3.9667e1	-3.9848e1	-4.0006e1	-4.0141e1	-4.0255e1	-4.0352e1	-4.0432e1	-4.0499e1	-4.0553e1
-2.9135e1	-2.9057e1	-2.8999e1	-2.8972e1	-2.8595e1	-2.8643e1	-2.8204e1	-2.957e1	-2.9858e1	-3.0126e1
-3.1456e1	-3.1656e1	-3.4507e1	-3.4507e1	-3.4522e1	-3.4551e1	-3.4314e1	-3.5746e1	-3.5847e1	-3.8346e1
-3.8453e1	-3.8546e1	-3.9771e1	-3.9919e1	-4.0048e1	-4.016e1	-4.0256e1	-4.0338e1	-4.0407e1	-4.0465e1
-2.9232e1	-2.9175e1	-2.9136e1	-2.8723e1	-2.8734e1	-2.8771e1	-2.9421e1	-2.9655e1	-2.9891e1	-3.0115e1
-3.1433e1	-3.1612e1	-3.1763e1	-3.4576e1	-3.4586e1	-3.4606e1	-3.4634e1	-3.5769e1	-3.5855e1	-3.8344e1
-3.8439e1	-3.8524e1	-3.9712e1	-3.985e1	-3.9973e1	-4.0081e1	-4.0175e1	-4.0257e1	-4.0327e1	-4.0386e1
-2.9316e1	-2.9275e1	-2.8843e1	-2.8833e1	-2.8843e1	-2.8872e1	-2.9533e1	-2.9727e1	-2.9923e1	-3.0112e1
-3.142e1	-3.158e1	-3.1718e1	-3.4632e1	-3.4639e1	-3.4653e1	-3.4674e1	-3.4421e1	-3.5867e1	-3.5937e1
-3.8434e1	-3.851e1	-3.8579e1	-3.9797e1	-3.9913e1	-4.0016e1	-4.0107e1	-4.0187e1	-4.0256e1	-4.0317e1
-2.939e1	-2.9359e1	-2.8929e1	-2.8923e1	-2.8931e1	-2.8954e1	-2.9624e1	-2.9787e1	-2.9953e1	-3.0114e1
-3.1414e1	-3.1557e1	-3.1683e1	-3.1793e1	-3.4684e1	-3.4694e1	-3.471e1	-3.4445e1	-3.5882e1	-3.5942e1
-3.8435e1	-3.8504e1	-3.8566e1	-3.9756e1	-3.9864e1	-3.9962e1	-4.0049e1	-4.0127e1	-4.0195e1	-4.0256e1
-2.9455e1	-2.9014e1	-2.9e1	-2.8997e1	-2.9004e1	-3.0159e1	-3.1005e1	-2.9839e1	-2.998e1	-3.0119e1
-3.1414e1	-3.1541e1	-3.1656e1	-3.1758e1	-3.4722e1	-3.473e1	-3.4742e1	-3.4467e1	-3.5898e1	-3.5951e1
-3.6001e1	-3.8502e1	-3.8559e1	-3.8611e1	-3.9826e1	-3.9918e1	-4.0001e1	-4.0076e1	-4.0143e1	-4.0202e1
11	1. (10G11.4)			-1 Vcont Layer - 2					
1.5134e-2	1.5313e-2	1.5519e-2	1.5734e-2	1.5937e-2	1.6102e-2	1.5564e-2	1.5217e-2	1.3415e-2	8.765e-3
8.215e-3	6.6047e-3	6.3104e-3	6.1407e-3	6.0625e-3	6.1103e-3	6.5e-3	6.8635e-3	7.0515e-3	7.1287e-3
7.153e-3	7.1549e-3	7.054e-3	7.6019e-3	7.5934e-3	7.5867e-3	7.5812e-3	7.5767e-3	7.5727e-3	7.5697e-3
1.7537e-3	1.7783e-3	1.808e-3	1.8409e-3	1.8724e-3	1.8979e-3	1.8563e-3	1.8111e-3	1.7351e-3	1.0344e-3
9.5809e-4	8.8913e-4	7.3133e-4	6.7451e-4	6.5729e-4	6.8906e-4	7.7537e-4	8.2938e-4	8.466e-4	8.487e-4
8.4645e-4	8.8987e-4	8.8813e-4	8.8674e-4	8.857e-4	8.8484e-4	8.8419e-4	8.8372e-4	8.8329e-4	8.829e-4
1.7346e-3	1.762e-3	1.7987e-3	1.842e-3	1.886e-3	1.9212e-3	1.9058e-3	1.8588e-3	1.7624e-3	1.172e-3
9.6032e-4	8.9381e-4	7.5197e-4	6.7005e-4	6.3477e-4	6.9991e-4	8.2284e-4	8.7233e-4	8.7409e-4	8.962e-4

8.9245e-4	8.8965e-4	8.8769e-4	8.8622e-4	8.8518e-4	8.844e-4	8.838e-4	8.8333e-4	8.8294e-4	8.826e-4
1.4471e-3	1.7331e-3	1.776e-3	1.834e-3	1.8975e-3	1.9484e-3	2.0084e-3	1.9179e-3	1.7991e-3	1.1495e-3
9.5728e-4	9.0835e-4	8.1453e-4	7.3998e-4	7.0365e-4	7.794e-4	8.738e-4	9.0813e-4	9.0311e-4	8.9615e-4
8.9149e-4	8.8856e-4	8.8665e-4	8.854e-4	8.8449e-4	8.838e-4	8.8329e-4	8.8286e-4	8.8813e-4	8.883e-4
1.4091e-3	1.4282e-3	1.7281e-3	1.8016e-3	1.8963e-3	1.9754e-3	2.02e-3	2.0124e-3	1.8379e-3	1.1177e-3
9.7143e-4	9.1288e-4	8.7832e-4	8.353e-4	7.7497e-4	9.175e-4	8.9439e-4	9.0401e-4	8.9828e-4	8.9214e-4
8.8856e-4	8.8644e-4	8.8509e-4	8.8419e-4	8.835e-4	8.8303e-4	8.88e-4	8.8834e-4	8.8861e-4	8.8882e-4
1.2707e-3	1.3699e-3	1.3892e-3	1.454e-3	1.8478e-3	1.9905e-3	2.027e-3	2.0151e-3	1.8386e-3	1.09e-3
9.2089e-4	9.069e-4	9.0029e-4	9.1403e-4	9.0172e-4	8.9713e-4	8.9289e-4	8.9083e-4	8.8449e-4	8.8466e-4
8.8415e-4	8.8359e-4	8.8311e-4	8.8273e-4	8.8238e-4	8.8808e-4	8.8869e-4	8.8904e-4	8.893e-4	8.8943e-4
1.2573e-3	1.2484e-3	1.2398e-3	1.3116e-3	1.4042e-3	1.9137e-3	2.0064e-3	1.9751e-3	1.6375e-3	9.9557e-4
9.3273e-4	9.0745e-4	9.0645e-4	9.1574e-4	8.9219e-4	8.9953e-4	8.9136e-4	8.8354e-4	8.8415e-4	8.844e-4
8.7973e-4	8.8063e-4	8.8101e-4	8.7633e-4	8.7739e-4	8.7811e-4	8.7854e-4	8.7879e-4	8.7884e-4	8.7884e-4
1.2498e-3	1.2358e-3	1.2159e-3	1.1958e-3	1.2248e-3	1.3575e-3	1.642e-3	1.542e-3	1.5053e-3	1.333e-3
9.7527e-4	9.0511e-4	9.0507e-4	9.1896e-4	9.0134e-4	8.898e-4	8.8009e-4	8.7892e-4	8.8204e-4	8.8337e-4
8.8397e-4	8.8436e-4	8.9824e-4	8.8987e-4	8.9944e-4	8.9984e-4	9.0006e-4	9.002e-4	9.0015e-4	9.0015e-4
1.184e-3	1.1912e-3	1.2265e-3	1.1825e-3	1.1927e-3	1.2482e-3	1.5629e-3	1.5126e-3	1.4388e-3	1.365e-3
1.1838e-3	8.9972e-4	9.0089e-4	9.482e-4	9.6392e-4	9.3937e-4	8.7487e-4	8.7697e-4	8.8093e-4	8.826e-4
8.9074e-4	8.9417e-4	8.9624e-4	8.9726e-4	8.9762e-4	8.9272e-4	8.9285e-4	9.0091e-4	9.0078e-4	9.006e-4
1.187e-3	1.2064e-3	1.2313e-3	1.2542e-3	1.2376e-3	1.3107e-3	1.7434e-3	1.5567e-3	1.4537e-3	1.2867e-3
9.9533e-4	9.1249e-4	9.1784e-4	9.5802e-4	9.7674e-4	9.7864e-4	9.3951e-4	9.1606e-4	9.0922e-4	8.9307e-4
8.9873e-4	9.0168e-4	9.0235e-4	9.019e-4	9.0114e-4	9.0029e-4	8.9953e-4	9.0523e-4	8.9329e-4	8.9302e-4
1.181e-3	1.2109e-3	1.2845e-3	1.3399e-3	1.3995e-3	1.5897e-3	1.6022e-3	1.4795e-3	1.4815e-3	1.0882e-3
9.485e-4	9.0098e-4	9.5605e-4	9.5741e-4	9.9528e-4	9.8635e-4	9.6556e-4	9.5469e-4	9.491e-4	9.5029e-4
9.5151e-4	9.1982e-4	9.1e-4	9.0731e-4	9.0496e-4	9.0311e-4	9.0168e-4	9.0047e-4	8.9958e-4	8.9877e-4
1.1017e-3	1.1205e-3	1.2053e-3	1.22e-3	1.2418e-3	2.1403e-3	1.481e-3	1.2166e-3	1.0922e-3	9.5615e-4
9.4015e-4	9.3319e-4	1.0785e-3	1.1901e-3	1.0532e-3	1.0102e-3	1.0051e-3	1.0194e-3	9.6398e-4	9.6675e-4
9.6525e-4	9.605e-4	9.5655e-4	9.2087e-4	9.1694e-4	9.0568e-4	9.0361e-4	9.0203e-4	9.0078e-4	8.998e-4
1.1072e-3	1.1353e-3	1.0907e-3	1.004e-3	9.7762e-4	1.4282e-3	9.6633e-4	1.1153e-3	9.267e-4	9.3046e-4
9.6593e-4	1.1004e-3	1.5141e-3	1.6108e-3	1.2728e-3	1.1436e-3	1.1269e-3	1.036e-3	1.0609e-3	1.0727e-3
9.7428e-4	9.6711e-4	9.6096e-4	9.5711e-4	9.5399e-4	9.5349e-4	9.1472e-4	9.2244e-4	9.1445e-4	9.0065e-4
1.0986e-3	1.0691e-3	1.0167e-3	9.5908e-4	9.0933e-4	1.3048e-3	1.1536e-3	9.0538e-4	8.9343e-4	9.0282e-4
9.4712e-4	1.2452e-3	1.5266e-3	1.5207e-3	1.3535e-3	1.3091e-3	1.0105e-3	1.0764e-3	1.1205e-3	1.1624e-3
1.1006e-3	1.0922e-3	1.0849e-3	1.0797e-3	9.561e-4	9.5364e-4	9.5183e-4	9.5241e-4	9.1284e-4	9.1146e-4
1.1128e-3	1.096e-3	1.0657e-3	1.0422e-3	9.906e-4	1.0674e-3	9.7479e-4	8.718e-4	8.9732e-4	8.908e-4
1.0764e-3	1.3915e-3	1.4193e-3	1.3191e-3	1.2401e-3	1.2408e-3	1.2536e-3	1.2272e-3	1.0971e-3	1.1338e-3
1.1442e-3	1.1318e-3	1.1341e-3	1.0945e-3	1.0889e-3	1.0848e-3	1.0819e-3	9.5158e-4	9.5047e-4	9.5166e-4
1.1436e-3	1.0928e-3	1.1424e-3	1.1779e-3	1.1589e-3	1.0594e-3	9.5842e-4	8.9133e-4	8.8701e-4	9.6612e-4
1.2745e-3	1.6639e-3	1.47e-3	1.2851e-3	1.1615e-3	1.2307e-3	1.2365e-3	1.3169e-3	1.3969e-3	1.3122e-3
1.1174e-3	1.113e-3	1.102e-3	1.0898e-3	1.0789e-3	1.0294e-3	1.0282e-3	1.0197e-3	1.0851e-3	1.0831e-3
1.0658e-3	1.1124e-3	1.2124e-3	1.4522e-3	1.3322e-3	1.1474e-3	9.5014e-4	9.242e-4	9.3079e-4	9.9983e-4
1.42e-3	1.7311e-3	1.5448e-3	1.3076e-3	1.2153e-3	1.2475e-3	1.2795e-3	1.3528e-3	1.4183e-3	1.4091e-3
1.2964e-3	1.3047e-3	1.0904e-3	1.0826e-3	1.0746e-3	1.0673e-3	1.0608e-3	1.0235e-3	1.0186e-3	1.0146e-3
1.0411e-3	1.0492e-3	1.1281e-3	1.2333e-3	1.1186e-3	9.6448e-4	9.0728e-4	8.9821e-4	9.5721e-4	1.1264e-3
1.3827e-3	1.3747e-3	1.3426e-3	1.4851e-3	1.306e-3	1.2925e-3	1.3179e-3	1.3325e-3	1.4258e-3	1.4766e-3
1.5216e-3	1.5544e-3	1.2814e-3	1.279e-3	1.3065e-3	1.0642e-3	1.059e-3	1.0543e-3	1.0123e-3	1.0158e-3
9.6917e-4	9.6943e-4	9.5398e-4	8.8158e-4	8.0084e-4	7.9373e-4	8.5982e-4	9.0833e-4	1.053e-3	1.1695e-3
1.3128e-3	1.1901e-3	1.1155e-3	1.1154e-3	1.256e-3	1.1839e-3	1.1907e-3	1.1937e-3	1.4455e-3	1.478e-3
1.5094e-3	1.5343e-3	1.553e-3	1.5649e-3	1.264e-3	1.2604e-3	1.2562e-3	1.0529e-3	1.0493e-3	1.0461e-3
9.2679e-4	8.9964e-4	8.3949e-4	7.6011e-4	6.8884e-4	7.0624e-4	8.0105e-4	9.2725e-4	1.1005e-3	1.1235e-3
1.2155e-3	1.0596e-3	1.0257e-3	1.0886e-3	1.1828e-3	1.2517e-3	1.1792e-3	1.1857e-3	1.1893e-3	1.2646e-3
1.2914e-3	1.3144e-3	1.3312e-3	1.5528e-3	1.5599e-3	1.5655e-3	1.5675e-3	1.2479e-3	1.2448e-3	1.0454e-3
8.5451e-4	8.3844e-4	8.1714e-4	7.5745e-4	7.1851e-4	7.5068e-4	8.1662e-4	8.5281e-4	9.0213e-4	1.0872e-3
1.2013e-3	1.1359e-3	1.0844e-3	1.0988e-3	1.0291e-3	1.2041e-3	1.2239e-3	1.1779e-3	1.1832e-3	1.2479e-3
1.2708e-3	1.291e-3	1.3075e-3	1.3199e-3	1.3278e-3	1.3333e-3	1.3371e-3	1.5625e-3	1.5628e-3	1.5624e-3
8.4852e-4	8.5383e-4	8.204e-4	7.8606e-4	7.7578e-4	7.9311e-4	8.3114e-4	8.4899e-4	9.3588e-4	9.9099e-4
1.2163e-3	1.1885e-3	1.1191e-3	1.1158e-3	1.1137e-3	1.2702e-3	1.2179e-3	1.2291e-3	1.1622e-3	1.2356e-3
1.2556e-3	1.2736e-3	1.2888e-3	1.3011e-3	1.3103e-3	1.3161e-3	1.3205e-3	1.3241e-3	1.3253e-3	1.3256e-3
7.2263e-3	7.3302e-3	7.1417e-3	8.1392e-4	8.1995e-4	8.2822e-4	8.5063e-4	8.5255e-4	9.3012e-4	9.7433e-4
1.2328e-3	1.2196e-3	1.1368e-3	1.1293e-3	1.1239e-3	1.1102e-3	1.2914e-3	1.3024e-3	1.2333e-3	1.162e-3
1.2444e-3	1.2605e-3	1.2745e-3	1.2862e-3	1.2955e-3	1.3028e-3	1.3072e-3	1.3117e-3	1.3142e-3	1.3155e-3
7.3597e-3	7.3796e-3	7.257e-3	8.5222e-4	8.4808e-4	8.5367e-4	8.3628e-4	8.5807e-4	9.2779e-4	9.629e-4
1.072e-3	1.2399e-3	1.1457e-3	1.1379e-3	1.1317e-3	1.0355e-3	1.2948e-3	1.3038e-3	1.3108e-3	1.2366e-3
1.3317e-3	1.2506e-3	1.2634e-3	1.2744e-3	1.2836e-3	1.2909e-3	1.2957e-3	1.3011e-3	1.3042e-3	1.3063e-3
7.5245e-3	7.4374e-3	7.5472e-3	8.6992e-4	8.68e-4	8.7205e-4	8.4757e-4	9.0974e-4	9.2741e-4	9.5529e-4
1.0628e-3	1.2534e-3	1.1509e-3	1.1438e-3	1.1377e-3	1.0387e-3	1.1185e-3	1.3064e-3	1.3123e-3	1.3171e-3
1.2393e-3	1.3414e-3	1.2548e-3	1.2651e-3	1.2738e-3	1.2811e-3	1.2862e-3	1.2909e-3	1.2945e-3	1.2972e-3
7.5552e-3	7.6973e-3	7.6073e-3	8.8339e-4	8.8253e-4	8.6992e-4	8.5621e-4	9.1747e-4	9.2798e-4	9.5029e-4
1.056e-3	1.073e-3	1.1539e-3	1.1476e-3	1.1421e-3	1.1372e-3	1.1208e-3	1.1212e-3	1.3143e-3	1.3184e-3
1.322e-3	1.4438e-3	1.3486e-3	1.2575e-3	1.2659e-3	1.273e-3	1.278e-3	1.283e-3	1.2876e-3	1.2908e-3
7.8039e-3	7.7568e-3	7.6825e-3	8.937e-4	8.7707e-4	8.794e-4	8.628e-4	9.2373e-4	9.2903e-4	9.4707e-4
1.0511e-3	1.0668e-3	1.1558e-3	1.1503e-3	1.1454e-3	1.1409e-3	1.0379e-3	1.123e-3	1.3167e-3	1.3201e-3
1.3232e-3	1.4402e-3	1.4542e-3	1.3539e-3	1.2595e-3	1.2661e-3	1.272e-3	1.2769e-3	1.2811e-3	1.2844e-3
7.8421e-3	7.7708e-3	7.7441e-3	7.7294e-3	7.584e-3	7.5992e-3	7.4393e-3	7.9611e-3	7.9725e-3	8.0995e-3
8.9812e-3	9.101e-3	9.9169e-3	9.876e-3	9.8379e-3	9.8038e-3	8.9082e-3	9.6391e-3	9.6397e-3	1.133e-2
1.1352e-2	1.1372e-2	1.2433e-2	1.2532e-2	1.1638e-2	1.0804e-2	1.0852e-2	1.0894e-2	1.0929e-2	1.0959e-2
7.8774e-3	7.8133e-3	7.7949e-3	7.6339e-3	7.6354e-3	7.6478e-3	7.9004e-3	7.9967e-3	7.9827e-3	8.0886e-3
8.9631e-3	9.0687e-3	9.1605e-3	9.8885e-3	9.8547e-3	9.8236e-3	9.7951e-3	9.6511e-3	9.6505e-3	1.1346e-2
1.1366e-2	1.1383e-2	1.2412e-2	1.2502e-2	1.2586e-2	1.1664e-2	1.0811e-2	1.0852e-2	1.0887e-2	1.0916e-2
7.8691e-3	7.8504e-3	7.6803e-3	7.6742e-3	7.6765e-3	7.6863e-3	7.946e-3	8.0264e-3	7.9926e-3	8.0819e-3
8.9512e-3	9.0449e-3	9.1277e-3	9.8973e-3	9.8672e-3	9.8391e-3	9.8136e-3	8.902e-3	9.6601e-3	9.6601e-3
1.1379e-2	1.1393e-2	1.1408e-2	1.2481e-2	1.2559e-2	1.263e-2	1.1684e-2	1.0815e-2	1.0849e-2	1.088e-2
7.8958e-3	7.8818e-3	7.7119e-3	7.7077e-3	7.7096e-3	7.7176e-3	7.9831e-3	8.0513e-3	8.002e-3	8.0781e-3
8.9435e-3	9.0271e-3	9.1021e-3	8.3666e-3	9.8778e-3	9.8522e-3	9.8291e-3	8.9092e-3	9.6691e-3	9.6679e-3
1.1392e-2	1.1405e-2	1.1416e-2	1.2466e-2	1.2537e-2	1.2603e-2	1.2663e-2	1.1699e-2	1.0817e-2	1.0847e-2
7.9199e-3	7.7445e-3	7.738e-3	7.7353e-3	7.7372e-3	8.208e-3	8.5917e-3	8.0726e-3	8.0107e-3	8.076e-3
8.9399e-3	9.014e-3	9.0819e-3	8.337e-3	9.886e-3	9.8634e-3	9.8422e-3	9.6457e-3	9.6763e-3	9.6751e-3
9.6739e-3	1.1416e-2	1.1426e-2	1.1436e-2	1.2521e-2	1.2583e-2	1.2639e-2	1.2691e-2	1.171e-2	1.0818e-2

11 1. (10G11.4) -1 Aquifer Top - 2

-1.976e1	-1.9779e1	-1.98e1	-1.9822e1	-1.9842e1	-1.9858e1	-2.0945e1	-2.1159e1	-2.1017e1	-2.6904e1
-2.7194e1	-2.8605e1	-2.8224e1	-2.8473e1	-2.8619e1	-3.0485e1	-3.1919e1	-3.2855e1	-3.3323e1	-3.3543e1
-3.365e1	-3.3705e1	-3.3998e1	-3.5341e1	-3.5379e1	-3.541e1	-3.5435e1	-3.5456e1	-3.5473e1	-3.5487e1
-1.9749e1	-1.9771e1	-1.9798e1	-1.9826e1	-1.9853e1	-1.9873e1	-2.0742e1	-2.0971e1	-2.1381e1	-2.6978e1
-2.7394e1	-2.7469e1	-2.7983e1	-2.717e1	-2.7297e1	-2.9806e1	-3.2241e1	-3.3346e1	-3.3708e1	-3.3822e1
-3.386e1	-3.5224e1	-3.5295e1	-3.5349e1	-3.539e1	-3.5422e1	-3.5447e1	-3.5467e1	-3.5483e1	-3.5496e1
-1.973e1	-1.9756e1	-1.979e1	-1.9827e1	-1.9864e1	-1.9892e1	-2.0503e1	-2.0729e1	-2.123e1	-2.5898e1
-2.7727e1	-2.7861e1	-2.8122e1	-2.6931e1	-2.6595e1	-3.0111e1	-3.3157e1	-3.4003e1	-3.4106e1	-3.4967e1
-3.5123e1	-3.5236e1	-3.5314e1	-3.537e1	-3.541e1	-3.544e1	-3.5464e1	-3.5482e1	-3.5496e1	-3.5508e1
-1.8905e1	-1.9729e1	-1.9769e1	-1.982e1	-1.9873e1	-1.9913e1	-2.0158e1	-2.0448e1	-2.1033e1	-2.6132e1
-2.8209e1	-2.8477e1	-2.8861e1	-2.8043e1	-2.899e1	-3.2144e1	-3.4043e1	-3.444e1	-3.4681e1	-3.4977e1
-3.5167e1	-3.5283e1	-3.5357e1	-3.5406e1	-3.544e1	-3.5466e1	-3.5485e1	-3.55e1	-3.5496e1	-3.5506e1
-1.8832e1	-1.887e1	-1.9724e1	-1.9792e1	-1.9872e1	-1.9933e1	-2.0041e1	-2.0117e1	-2.0833e1	-2.6479e1
-2.8372e1	-2.9081e1	-2.9356e1	-2.9324e1	-3.2606e1	-3.4812e1	-3.5079e1	-3.4674e1	-3.4911e1	-3.5158e1
-3.5294e1	-3.5373e1	-3.5422e1	-3.5455e1	-3.5479e1	-3.5497e1	-3.5495e1	-3.5506e1	-3.5515e1	-3.5522e1
-1.8155e1	-1.8752e1	-1.8793e1	-1.892e1	-1.9832e1	-1.9909e1	-1.9971e1	-2.0091e1	-2.0449e1	-2.6798e1
-2.9124e1	-2.9384e1	-2.9434e1	-3.0408e1	-3.4734e1	-3.553e1	-3.5673e1	-3.5778e1	-3.5565e1	-3.5485e1
-3.548e1	-3.5491e1	-3.5503e1	-3.5514e1	-3.5524e1	-3.5516e1	-3.5523e1	-3.5529e1	-3.5534e1	-3.5538e1
-1.8075e1	-1.813e1	-1.8206e1	-1.8626e1	-1.8819e1	-1.9772e1	-2.0179e1	-2.0504e1	-2.3827e1	-2.7767e1
-2.8892e1	-2.9272e1	-2.941e1	-3.0627e1	-3.5505e1	-3.5414e1	-3.5703e1	-3.5904e1	-3.5765e1	-3.5703e1
-3.5654e1	-3.5607e1	-3.5585e1	-3.5558e1	-3.5553e1	-3.5552e1	-3.5551e1	-3.5552e1	-3.5552e1	-3.5554e1

-1.6988e1	-1.8027e1	-1.8131e1	-1.824e1	-1.8397e1	-1.8705e1	-2.3843e1	-2.4395e1	-2.4527e1	-2.5141e1
-2.8108e1	-2.8482e1	-2.8424e1	-3.1028e1	-3.5204e1	-3.5416e1	-3.5443e1	-3.5631e1	-3.5662e1	-3.5655e1
-3.5646e1	-3.5639e1	-3.5614e1	-3.5791e1	-3.5162e1	-3.5158e1	-3.5155e1	-3.5152e1	-3.5149e1	-3.5146e1
-1.6782e1	-1.7091e1	-1.7562e1	-1.8169e1	-1.8162e1	-1.9245e1	-2.3985e1	-2.4616e1	-2.4719e1	-2.4651e1
-2.451e1	-2.654e1	-2.6787e1	-3.2301e1	-3.4227e1	-3.4433e1	-3.5175e1	-3.5427e1	-3.5563e1	-3.5604e1
-3.5599e1	-3.5599e1	-3.5598e1	-3.5596e1	-3.5595e1	-3.5769e1	-3.5767e1	-3.5178e1	-3.5171e1	-3.5165e1
-1.6422e1	-1.6606e1	-1.6821e1	-1.7248e1	-1.8053e1	-1.8243e1	-2.4059e1	-2.4552e1	-2.466e1	-2.4595e1
-2.4408e1	-2.434e1	-2.7069e1	-3.1224e1	-3.3827e1	-3.4149e1	-3.4597e1	-3.4893e1	-3.5034e1	-3.5558e1
-3.5574e1	-3.558e1	-3.5583e1	-3.5585e1	-3.5586e1	-3.5587e1	-3.5588e1	-3.5588e1	-3.5763e1	-3.5764e1
-1.5935e1	-1.5958e1	-1.6067e1	-1.617e1	-1.6236e1	-1.8686e1	-2.1838e1	-2.3429e1	-2.4251e1	-2.4525e1
-2.4541e1	-2.4534e1	-2.5989e1	-3.1102e1	-3.3725e1	-3.4097e1	-3.4333e1	-3.4472e1	-3.4722e1	-3.4968e1
-3.5097e1	-3.5666e1	-3.5572e1	-3.5576e1	-3.5579e1	-3.5581e1	-3.5583e1	-3.5584e1	-3.5584e1	-3.5585e1
-1.4188e1	-1.4177e1	-1.408e1	-1.3097e1	-1.3492e1	-1.9177e1	-2.1247e1	-2.2085e1	-2.2697e1	-2.3243e1
-2.447e1	-2.4972e1	-2.6544e1	-2.9771e1	-3.2452e1	-3.3662e1	-3.3694e1	-3.4527e1	-3.4905e1	-3.5276e1
-3.5374e1	-3.528e1	-3.516e1	-3.5673e1	-3.5699e1	-3.5577e1	-3.5579e1	-3.558e1	-3.5581e1	-3.5582e1
-1.4075e1	-1.3919e1	-1.3465e1	-1.1787e1	-1.1289e1	-1.8996e1	-2.1976e1	-2.2462e1	-2.3339e1	-2.2685e1
-2.3641e1	-2.5112e1	-2.6903e1	-2.7287e1	-3.0316e1	-3.176e1	-3.332e1	-3.3824e1	-3.5093e1	-3.549e1
-3.5536e1	-3.5383e1	-3.5224e1	-3.5104e1	-3.5017e1	-3.523e1	-3.5716e1	-3.5729e1	-3.5579e1	-3.558e1
-1.4094e1	-1.4044e1	-1.4364e1	-1.5216e1	-1.5619e1	-1.9307e1	-2.1329e1	-2.3504e1	-2.3859e1	-2.0682e1
-2.1888e1	-2.5377e1	-2.6792e1	-2.6613e1	-2.5478e1	-2.5161e1	-2.7657e1	-3.2996e1	-3.4149e1	-3.5083e1
-3.5458e1	-3.535e1	-3.5216e1	-3.5106e1	-3.5022e1	-3.496e1	-3.4912e1	-3.5187e1	-3.5729e1	-3.5739e1
-1.5235e1	-1.5314e1	-1.5442e1	-1.5609e1	-1.5916e1	-1.8368e1	-2.1458e1	-2.276e1	-2.011e1	-1.7746e1
-1.9305e1	-2.2346e1	-2.6985e1	-2.5957e1	-2.485e1	-2.4827e1	-2.4933e1	-2.7427e1	-3.0616e1	-3.2558e1
-3.3284e1	-3.3081e1	-3.423e1	-3.5074e1	-3.5006e1	-3.4951e1	-3.4908e1	-3.4873e1	-3.4845e1	-3.5158e1
-1.5865e1	-1.6307e1	-1.7068e1	-1.8716e1	-1.8367e1	-1.8942e1	-1.7912e1	-1.6904e1	-1.6753e1	-1.748e1
-2.0139e1	-2.0509e1	-2.577e1	-2.536e1	-2.4177e1	-2.4597e1	-2.4831e1	-2.6535e1	-2.8269e1	-2.993e1
-3.1498e1	-3.1739e1	-3.1609e1	-3.1345e1	-3.1061e1	-3.0801e1	-3.0649e1	-3.3478e1	-3.484e1	-3.4819e1
-1.7536e1	-1.7945e1	-1.8828e1	-2.0241e1	-1.9505e1	-1.794e1	-1.6865e1	-1.5916e1	-1.5927e1	-1.923e1
-2.2696e1	-1.837e1	-1.9759e1	-2.4998e1	-2.4463e1	-2.4652e1	-2.4836e1	-2.6083e1	-2.7275e1	-2.8478e1
-2.9363e1	-2.9816e1	-3.069e1	-3.0658e1	-3.0546e1	-3.0407e1	-3.0267e1	-3.0207e1	-3.0099e1	-3.0002e1
-1.7087e1	-1.7311e1	-1.7829e1	-1.8489e1	-1.7479e1	-1.6114e1	-1.5226e1	-1.6158e1	-1.711e1	-2.0724e1
-2.501e1	-2.4847e1	-2.1435e1	-2.1306e1	-2.4869e1	-2.4848e1	-2.4921e1	-2.4999e1	-2.6757e1	-2.7628e1
-2.8356e1	-2.8843e1	-2.9096e1	-2.9179e1	-3.0052e1	-3.0016e1	-2.9953e1	-2.9881e1	-2.9806e1	-2.9813e1
-1.6519e1	-1.6371e1	-1.6045e1	-1.5104e1	-1.4372e1	-1.4474e1	-1.4586e1	-1.5179e1	-1.8633e1	-2.1247e1
-2.3846e1	-2.3361e1	-2.271e1	-2.2151e1	-2.2644e1	-2.4262e1	-2.4311e1	-2.4346e1	-2.6507e1	-2.7149e1
-2.7727e1	-2.8171e1	-2.8465e1	-2.8628e1	-2.8695e1	-2.8699e1	-2.8665e1	-2.9632e1	-2.9597e1	-2.9557e1
-1.601e1	-1.5615e1	-1.4719e1	-1.3969e1	-1.4265e1	-1.3593e1	-1.4065e1	-1.4697e1	-1.9522e1	-2.242e1
-2.3127e1	-2.293e1	-2.2844e1	-2.249e1	-2.2531e1	-2.2648e1	-2.4257e1	-2.4308e1	-2.4342e1	-2.6104e1
-2.6601e1	-2.7017e1	-2.7328e1	-2.8198e1	-2.8313e1	-2.8369e1	-2.8384e1	-2.8372e1	-2.8344e1	-2.9386e1
-1.5674e1	-1.4883e1	-1.4471e1	-1.3891e1	-1.346e1	-1.3683e1	-1.3921e1	-1.4415e1	-1.6447e1	-2.2336e1
-2.2864e1	-2.2811e1	-2.2712e1	-2.2505e1	-2.3214e1	-2.2553e1	-2.2616e1	-2.4273e1	-2.4315e1	-2.5855e1
-2.6265e1	-2.6625e1	-2.6917e1	-2.7135e1	-2.7285e1	-2.738e1	-2.7432e1	-2.8158e1	-2.8158e1	-2.8144e1
-1.504e1	-1.4854e1	-1.4502e1	-1.4154e1	-1.3963e1	-1.407e1	-1.3978e1	-1.4316e1	-1.9829e1	-2.1154e1
-2.2702e1	-2.2668e1	-2.2585e1	-2.245e1	-2.2294e1	-2.3961e1	-2.2546e1	-2.2583e1	-2.2606e1	-2.5691e1
-2.6035e1	-2.6346e1	-2.6611e1	-2.6824e1	-2.6984e1	-2.7099e1	-2.7176e1	-2.7222e1	-2.7245e1	-2.7252e1
-1.4981e1	-1.4871e1	-1.4633e1	-1.4428e1	-1.4331e1	-1.4392e1	-1.4079e1	-1.5497e1	-1.9598e1	-2.093e1
-2.2579e1	-2.2549e1	-2.2486e1	-2.2392e1	-2.2282e1	-2.4182e1	-2.4018e1	-2.4044e1	-2.2555e1	-2.257e1
-2.5875e1	-2.6145e1	-2.6383e1	-2.6583e1	-2.6743e1	-2.6866e1	-2.6957e1	-2.7021e1	-2.7062e1	-2.7086e1
-1.5096e1	-1.4935e1	-1.4775e1	-1.4649e1	-1.4595e1	-1.4632e1	-1.5113e1	-1.5653e1	-1.9504e1	-2.0564e1
-2.1379e1	-2.2458e1	-2.2408e1	-2.234e1	-2.226e1	-2.3283e1	-2.4032e1	-2.4052e1	-2.4068e1	-2.2532e1
-2.5764e1	-2.5999e1	-2.6212e1	-2.6396e1	-2.655e1	-2.6675e1	-2.6773e1	-2.6847e1	-2.69e1	-2.6937e1
-1.5129e1	-1.501e1	-1.4901e1	-1.4821e1	-1.4788e1	-1.4812e1	-1.5349e1	-1.8582e1	-1.9483e1	-2.0323e1
-2.1014e1	-2.2386e1	-2.2347e1	-2.2295e1	-2.2235e1	-2.3295e1	-2.4257e1	-2.4063e1	-2.4076e1	-2.4086e1
-2.2513e1	-2.5893e1	-2.6083e1	-2.6251e1	-2.6397e1	-2.6519e1	-2.6618e1	-2.6697e1	-2.6759e1	-2.6805e1
-1.5172e1	-1.5084e1	-1.5008e1	-1.4954e1	-1.4932e1	-1.5786e1	-1.5535e1	-1.8795e1	-1.9499e1	-2.017e1
-2.0749e1	-2.1074e1	-2.2298e1	-2.2257e1	-2.221e1	-2.216e1	-2.4282e1	-2.428e1	-2.4084e1	-2.4092e1
-2.41e1	-2.5816e1	-2.5985e1	-2.6138e1	-2.6274e1	-2.6391e1	-2.6489e1	-2.657e1	-2.6636e1	-2.6687e1
-1.5217e1	-1.5151e1	-1.5096e1	-1.5058e1	-1.5857e1	-1.5993e1	-1.5678e1	-1.8972e1	-1.9532e1	-2.0074e1
-2.0559e1	-2.0963e1	-2.2257e1	-2.2225e1	-2.2187e1	-2.2147e1	-2.3298e1	-2.4299e1	-2.4092e1	-2.4099e1
-2.4105e1	-2.5761e1	-2.5912e1	-2.6051e1	-2.6176e1	-2.6286e1	-2.6381e1	-2.6462e1	-2.6529e1	-2.6585e1
-1.526e1	-1.521e1	-1.5169e1	-1.5142e1	-1.6033e1	-1.6156e1	-1.5789e1	-1.9117e1	-1.9571e1	-2.0015e1
-2.0423e1	-2.0776e1	-2.2223e1	-2.2197e1	-2.2166e1	-2.2133e1	-2.3302e1	-2.4316e1	-2.4312e1	-2.4106e1
-2.4111e1	-2.4115e1	-2.5856e1	-2.5982e1	-2.6097e1	-2.62e1	-2.6291e1	-2.637e1	-2.6438e1	-2.6495e1
-1.53e1	-1.5261e1	-1.523e1	-1.6101e1	-1.6175e1	-1.6286e1	-1.8882e1	-1.9238e1	-1.9612e1	-1.9981e1
-2.0326e1	-2.0633e1	-2.0895e1	-2.2173e1	-2.2147e1	-2.212e1	-2.2092e1	-2.433e1	-2.4325e1	-2.4113e1
-2.4116e1	-2.412e1	-2.5815e1	-2.5929e1	-2.6034e1	-2.613e1	-2.6217e1	-2.6293e1	-2.6359e1	-2.6416e1
-1.5336e1	-1.5306e1	-1.6176e1	-1.622e1	-1.6291e1	-1.639e1	-1.904e1	-1.9339e1	-1.9652e1	-1.9963e1
-2.0257e1	-2.0525e1	-2.076e1	-2.2152e1	-2.213e1	-2.2107e1	-2.2083e1	-2.33e1	-2.4337e1	-2.4333e1
-2.4122e1	-2.4125e1	-2.4128e1	-2.5887e1	-2.5984e1	-2.6073e1	-2.6154e1	-2.6227e1	-2.6291e1	-2.6348e1
-1.5369e1	-1.5345e1	-1.6274e1	-1.632e1	-1.6386e1	-1.6474e1	-1.9171e1	-1.9425e1	-1.969e1	-1.9955e1
-2.0208e1	-2.0443e1	-2.0652e1	-2.0696e1	-2.2115e1	-2.2095e1	-2.2075e1	-2.3302e1	-2.4347e1	-2.4343e1
-2.4127e1	-2.4129e1	-2.4132e1	-2.5855e1	-2.5943e1	-2.6026e1	-2.6102e1	-2.6171e1	-2.6233e1	-2.6288e1
-1.5398e1	-1.6328e1	-1.6358e1	-1.6403e1	-1.6465e1	-1.6543e1	-1.928e1	-1.9499e1	-1.9726e1	-1.9953e1
-2.0173e1	-2.0379e1	-2.0567e1	-2.0733e1	-2.2101e1	-2.2084e1	-2.2067e1	-2.3303e1	-2.4356e1	-2.4352e1
-2.4348e1	-2.4133e1	-2.4135e1	-2.4137e1	-2.5911e1	-2.5988e1	-2.6059e1	-2.6124e1	-2.6183e1	-2.6237e1

11 1. (10G11.4) -1 Conductivity Layer - 3

7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3

9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
7.776e-2	7.776e-2	7.776e-2	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
7.776e-2	7.776e-2	7.776e-2	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
7.776e-2	7.776e-2	7.776e-2	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
7.776e-2	7.776e-2	7.776e-2	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
7.776e-2	7.776e-2	7.776e-2	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3	9.072e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2.	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2

11 1. (10G11.4) -1 Aquifer Bottom - 3

-5.1405e1	-5.1459e1	-5.1519e1	-5.158e1	-5.1636e1	-5.168e1	-5.2744e1	-5.2909e1	-5.3164e1	-5.7239e1
-5.7838e1	-6.1813e1	-6.2068e1	-6.2435e1	-6.2886e1	-6.4803e1	-6.5179e1	-6.5155e1	-6.5162e1	-6.5193e1
-6.5234e1	-6.5274e1	-6.5309e1	-6.5337e1	-6.536e1	-6.5378e1	-6.5393e1	-6.5404e1	-6.5414e1	-6.5422e1
-5.1373e1	-5.1437e1	-5.1512e1	-5.1591e1	-5.1666e1	-5.1723e1	-5.2588e1	-5.2764e1	-5.308e1	-5.731e1
-5.8108e1	-5.8653e1	-6.1857e1	-6.2305e1	-6.2909e1	-6.4803e1	-6.5111e1	-6.507e1	-6.5091e1	-6.515e1
-6.5214e1	-6.5269e1	-6.5311e1	-6.5343e1	-6.5367e1	-6.5386e1	-6.54e1	-6.5411e1	-6.542e1	-6.5428e1
-5.1322e1	-5.1395e1	-5.1488e1	-5.1595e1	-5.1697e1	-5.1775e1	-5.2405e1	-5.2579e1	-5.2963e1	-5.7436e1
-5.851e1	-5.9136e1	-6.1563e1	-6.2075e1	-6.2867e1	-6.4803e1	-6.5022e1	-6.4944e1	-6.5001e1	-6.5113e1
-6.5209e1	-6.5277e1	-6.5324e1	-6.5357e1	-6.538e1	-6.5397e1	-6.541e1	-6.542e1	-6.5428e1	-6.5435e1
-4.9761e1	-5.1318e1	-5.1431e1	-5.1575e1	-5.1723e1	-5.1834e1	-5.2182e1	-5.2362e1	-5.2812e1	-5.7652e1
-5.9072e1	-5.9725e1	-6.1272e1	-6.1731e1	-6.3344e1	-6.4808e1	-6.4955e1	-6.4784e1	-6.4936e1	-6.5122e1
-6.5239e1	-6.5308e1	-6.5351e1	-6.5379e1	-6.5398e1	-6.5412e1	-6.5423e1	-6.5431e1	-6.5438e1	-6.5443e1
-4.9605e1	-4.9685e1	-5.1305e1	-5.1496e1	-5.172e1	-5.1891e1	-5.2066e1	-5.2142e1	-5.2659e1	-5.7972e1
-5.9718e1	-6.0307e1	-6.0915e1	-6.1388e1	-6.4786e1	-6.4812e1	-6.5191e1	-6.4935e1	-6.5089e1	-6.5241e1
-6.5321e1	-6.5365e1	-6.5391e1	-6.5409e1	-6.5422e1	-6.5431e1	-6.5438e1	-6.5444e1	-6.5448e1	-6.5452e1
-4.8511e1	-4.9435e1	-4.9521e1	-4.9789e1	-5.1608e1	-5.19e1	-5.1996e1	-5.2115e1	-5.2179e1	-5.8267e1
-6.035e1	-6.0647e1	-6.0766e1	-6.1337e1	-6.4198e1	-6.503e1	-6.5289e1	-6.5596e1	-6.5534e1	-6.5453e1
-6.5437e1	-6.5437e1	-6.544e1	-6.5444e1	-6.5448e1	-6.5452e1	-6.5454e1	-6.5457e1	-6.5459e1	-6.5461e1
-4.834e1	-4.8404e1	-4.8502e1	-4.9165e1	-4.9583e1	-5.1688e1	-5.2203e1	-5.2526e1	-5.4095e1	-5.8793e1
-6.0086e1	-6.0595e1	-6.0805e1	-6.1479e1	-6.5222e1	-6.4951e1	-6.5217e1	-6.5687e1	-6.5597e1	-6.5577e1
-6.554e1	-6.5505e1	-6.5488e1	-6.573e1	-6.5729e1	-6.5729e1	-6.573e1	-6.5731e1	-6.5733e1	-6.5735e1
-4.8151e1	-4.8197e1	-4.8303e1	-4.8414e1	-4.8705e1	-4.9368e1	-5.4141e1	-5.4861e1	-5.5031e1	-5.6337e1
-5.9189e1	-6.0617e1	-6.0608e1	-6.1739e1	-6.5083e1	-6.536e1	-6.5768e1	-6.571e1	-6.5649e1	-6.5618e1
-6.5598e1	-6.5583e1	-6.5435e1	-6.5789e1	-6.5775e1	-6.5766e1	-6.576e1	-6.5756e1	-6.5754e1	-6.5752e1
-4.8158e1	-4.8062e1	-4.7856e1	-4.8313e1	-4.8405e1	-4.9686e1	-5.3818e1	-5.5314e1	-5.5325e1	-5.6088e1
-5.7674e1	-6.0606e1	-6.0566e1	-6.3789e1	-6.428e1	-6.4897e1	-6.6627e1	-6.6144e1	-6.5783e1	-6.5675e1
-6.5629e1	-6.5604e1	-6.5588e1	-6.5576e1	-6.5568e1	-6.58e1	-6.5788e1	-6.578e1	-6.5774e1	-6.577e1
-4.8073e1	-4.7762e1	-4.7371e1	-4.7372e1	-4.7905e1	-4.7687e1	-5.3065e1	-5.4689e1	-5.5438e1	-5.6765e1
-5.9015e1	-6.0477e1	-6.1482e1	-6.2799e1	-6.3932e1	-6.4025e1	-6.4824e1	-6.5284e1	-6.5321e1	-6.5705e1
-6.5651e1	-6.5619e1	-6.5599e1	-6.5586e1	-6.5575e1	-6.5568e1	-6.5562e1	-6.5414e1	-6.5793e1	-6.5786e1
-4.8127e1	-4.7626e1	-4.6478e1	-4.5691e1	-4.679e1	-4.8657e1	-5.1606e1	-5.4723e1	-5.491e1	-5.7685e1
-5.9411e1	-6.0492e1	-6.0041e1	-6.2686e1	-6.3563e1	-6.3855e1	-6.4248e1	-6.4695e1	-6.4945e1	-6.505e1
-6.5091e1	-6.5556e1	-6.5607e1	-6.5592e1	-6.5581e1	-6.5573e1	-6.5566e1	-6.5561e1	-6.5556e1	-6.5553e1
-4.8515e1	-4.8254e1	-4.763e1	-4.8081e1	-4.9275e1	-4.7465e1	-5.0884e1	-5.2971e1	-5.3897e1	-5.7633e1
-5.8797e1	-5.8848e1	-5.8359e1	-5.8961e1	-6.2018e1	-6.3323e1	-6.344e1	-6.3512e1	-6.4739e1	-6.4881e1
-6.4961e1	-6.5006e1	-6.5022e1	-6.5505e1	-6.5514e1	-6.5576e1	-6.5569e1	-6.5563e1	-6.5559e1	-6.5555e1
-4.9288e1	-4.9239e1	-4.9785e1	-5.1269e1	-5.234e1	-5.0557e1	-5.5277e1	-5.3895e1	-5.6101e1	-5.656e1
-5.7966e1	-5.7376e1	-5.4999e1	-5.4693e1	-5.8878e1	-6.0909e1	-6.1405e1	-6.3026e1	-6.3116e1	-6.3137e1
-6.4871e1	-6.4929e1	-6.4967e1	-6.4982e1	-6.4999e1	-6.5011e1	-6.549e1	-6.5286e1	-6.5283e1	-6.5557e1
-4.9556e1	-4.9863e1	-5.045e1	-5.1093e1	-4.9313e1	-5.1416e1	-5.2839e1	-5.5218e1	-5.6563e1	-5.6967e1
-5.7084e1	-5.6016e1	-5.512e1	-5.5226e1	-5.5807e1	-5.6082e1	-6.1035e1	-6.1336e1	-6.1479e1	-6.154e1
-6.2693e1	-6.2764e1	-6.2806e1	-6.2829e1	-6.4959e1	-6.4976e1	-6.4988e1	-6.4996e1	-6.5477e1	-6.5481e1
-4.9555e1	-4.9725e1	-4.9965e1	-5.0094e1	-5.0479e1	-5.1883e1	-5.3686e1	-5.5059e1	-5.5943e1	-5.7835e1
-5.4737e1	-5.2923e1	-5.5554e1	-5.5943e1	-5.6561e1	-5.6522e1	-5.6398e1	-5.7777e1	-6.08e1	-6.1044e1
-6.119e1	-6.1279e1	-6.1335e1	-6.2585e1	-6.2636e1	-6.267e1	-6.2693e1	-6.4972e1	-6.498e1	-6.4987e1
-4.9388e1	-4.932e1	-4.9091e1	-4.9125e1	-4.9677e1	-5.0501e1	-5.1562e1	-5.219e1	-5.2737e1	-5.3375e1
-5.1207e1	-4.9841e1	-5.4053e1	-5.6265e1	-5.7203e1	-5.6559e1	-5.6566e1	-5.6413e1	-5.6317e1	-5.7821e1

-6.0855e1	-6.1012e1	-6.1119e1	-6.1193e1	-6.1245e1	-6.1946e1	-6.1997e1	-6.2583e1	-6.2609e1	-6.2628e1
-4.9198e1	-4.895e1	-4.86e1	-4.7632e1	-4.8101e1	-4.9269e1	-5.0748e1	-5.0748e1	-5.0726e1	-5.0874e1
-4.9335e1	-4.7986e1	-4.9752e1	-5.5853e1	-5.6706e1	-5.6377e1	-5.6072e1	-5.5865e1	-5.5721e1	-5.6285e1
-5.776e1	-5.7851e1	-6.093e1	-6.1033e1	-6.1109e1	-6.1166e1	-6.121e1	-6.1906e1	-6.1949e1	-6.1982e1
-4.9089e1	-4.9219e1	-4.8645e1	-4.8126e1	-4.8268e1	-4.9228e1	-5.0541e1	-5.1038e1	-5.0635e1	-4.9547e1
-4.9104e1	-4.9196e1	-4.9013e1	-5.2095e1	-5.5789e1	-5.5923e1	-5.5672e1	-5.5544e1	-5.5433e1	-5.5344e1
-5.5272e1	-5.5214e1	-5.7812e1	-5.7871e1	-5.7917e1	-6.1061e1	-6.1117e1	-6.1161e1	-6.1844e1	-6.1888e1
-4.9617e1	-4.9336e1	-4.9025e1	-4.8542e1	-4.88e1	-4.9967e1	-5.0291e1	-5.0698e1	-4.9652e1	-4.9205e1
-4.8804e1	-4.8546e1	-4.8391e1	-4.9824e1	-5.1989e1	-5.4861e1	-5.5101e1	-5.5166e1	-5.5169e1	-5.5149e1
-5.5123e1	-5.5096e1	-5.5071e1	-5.5047e1	-5.7843e1	-5.7885e1	-5.7918e1	-6.1088e1	-6.113e1	-6.1165e1
-4.9695e1	-4.952e1	-4.8899e1	-4.8934e1	-4.9128e1	-5.0131e1	-5.0236e1	-4.9585e1	-4.9341e1	-4.899e1
-4.8535e1	-4.8163e1	-4.8173e1	-4.922e1	-5.1363e1	-5.1882e1	-5.4541e1	-5.4777e1	-5.4889e1	-5.4941e1
-5.4963e1	-5.497e1	-5.4968e1	-5.4963e1	-5.4955e1	-5.4946e1	-5.4937e1	-5.7895e1	-5.792e1	-6.1111e1
-4.9795e1	-4.9475e1	-4.9111e1	-4.9171e1	-4.9313e1	-4.9174e1	-4.9333e1	-4.9392e1	-4.9151e1	-4.9205e1
-4.8519e1	-4.8279e1	-4.8769e1	-4.9313e1	-5.101e1	-5.1779e1	-5.2282e1	-5.4447e1	-5.4635e1	-5.4743e1
-5.4807e1	-5.4844e1	-5.4866e1	-5.4877e1	-5.4883e1	-5.4885e1	-5.4884e1	-5.4882e1	-5.4879e1	-5.4876e1
-4.9652e1	-4.9241e1	-4.9258e1	-4.9318e1	-4.9177e1	-4.9166e1	-4.9251e1	-4.9271e1	-4.9389e1	-4.9186e1
-4.8579e1	-4.844e1	-4.9241e1	-4.9553e1	-4.9986e1	-5.1562e1	-5.1994e1	-5.2295e1	-5.3425e1	-5.4573e1
-5.4666e1	-5.4727e1	-5.4768e1	-5.4795e1	-5.4813e1	-5.4825e1	-5.4832e1	-5.4837e1	-5.4839e1	-5.484e1
-4.9729e1	-4.9335e1	-4.9361e1	-4.9413e1	-4.9083e1	-4.9151e1	-4.9196e1	-4.9198e1	-4.9352e1	-4.9206e1
-4.8636e1	-4.8543e1	-4.9549e1	-4.9756e1	-5.0042e1	-5.1497e1	-5.1842e1	-5.211e1	-5.2306e1	-5.3407e1
-5.4548e1	-5.4625e1	-5.4679e1	-5.4718e1	-5.4747e1	-5.4767e1	-5.4781e1	-5.4792e1	-5.4799e1	-5.4804e1
-4.9792e1	-4.9406e1	-4.9433e1	-4.9049e1	-4.9095e1	-4.9136e1	-4.916e1	-4.9155e1	-4.9341e1	-4.9234e1
-4.8679e1	-4.8612e1	-4.9759e1	-4.9911e1	-5.0112e1	-5.1502e1	-5.177e1	-5.1997e1	-5.2177e1	-5.2314e1
-5.3401e1	-5.4539e1	-5.4603e1	-5.465e1	-5.4686e1	-5.4713e1	-5.4734e1	-5.4749e1	-5.4761e1	-5.477e1
-4.9446e1	-4.9461e1	-4.8952e1	-4.9069e1	-4.9099e1	-4.9124e1	-4.9137e1	-4.913e1	-4.9341e1	-4.9262e1
-4.8712e1	-4.866e1	-4.9911e1	-5.0028e1	-5.0178e1	-5.1534e1	-5.1744e1	-5.1932e1	-5.2091e1	-5.2219e1
-5.2319e1	-5.3401e1	-5.4539e1	-5.4591e1	-5.4633e1	-5.4665e1	-5.469e1	-5.471e1	-5.4725e1	-5.4738e1
-4.9488e1	-4.8951e1	-4.9059e1	-4.908e1	-4.91e1	-4.9116e1	-4.9122e1	-4.9116e1	-4.9347e1	-4.9287e1
-4.8737e1	-4.8696e1	-5.0026e1	-5.012e1	-5.0236e1	-5.0365e1	-5.1743e1	-5.1898e1	-5.2035e1	-5.2151e1
-5.2246e1	-5.2323e1	-5.3403e1	-5.4542e1	-5.4586e1	-5.4622e1	-5.465e1	-5.4673e1	-5.4692e1	-5.4707e1
-4.8953e1	-4.8964e1	-4.9072e1	-4.9087e1	-4.9101e1	-4.911e1	-4.9113e1	-4.9108e1	-4.9355e1	-4.9308e1
-4.8756e1	-4.8722e1	-5.0116e1	-5.0193e1	-5.0286e1	-5.0389e1	-5.1754e1	-5.1883e1	-5.2e1	-5.2103e1
-5.2191e1	-5.2265e1	-5.2325e1	-5.3407e1	-5.4547e1	-5.4585e1	-5.4616e1	-5.4641e1	-5.4662e1	-5.4679e1
-4.8965e1	-4.9069e1	-4.908e1	-4.9091e1	-4.91e1	-4.9107e1	-4.9108e1	-4.9104e1	-4.9364e1	-4.9326e1
-4.8771e1	-4.8743e1	-5.0188e1	-5.0253e1	-5.0329e1	-5.0413e1	-5.1771e1	-5.1879e1	-5.1979e1	-5.2071e1
-5.2151e1	-5.222e1	-5.2278e1	-5.2327e1	-5.341e1	-5.4553e1	-5.4585e1	-5.4612e1	-5.4635e1	-5.4654e1
-4.8973e1	-4.9078e1	-4.9086e1	-4.9094e1	-4.9101e1	-4.9105e1	-4.9105e1	-4.9102e1	-4.9372e1	-4.9341e1
-4.8783e1	-4.876e1	-4.8739e1	-5.0302e1	-5.0366e1	-5.0436e1	-5.051e1	-5.1882e1	-5.1969e1	-5.2049e1
-5.2121e1	-5.2185e1	-5.224e1	-5.2288e1	-5.2328e1	-5.3413e1	-5.4559e1	-5.4587e1	-5.4611e1	-5.4631e1
-4.9078e1	-4.9084e1	-4.9091e1	-4.9097e1	-4.9101e1	-4.9104e1	-4.9104e1	-4.9102e1	-4.938e1	-4.9354e1
-4.8793e1	-4.8773e1	-4.8755e1	-5.0344e1	-5.0399e1	-5.0458e1	-5.052e1	-5.189e1	-5.1965e1	-5.2035e1
-5.21e1	-5.2159e1	-5.221e1	-5.2256e1	-5.2295e1	-5.2328e1	-5.3416e1	-5.4565e1	-5.4589e1	-5.461e1
-4.9085e1	-4.9089e1	-4.9094e1	-4.9099e1	-4.9102e1	-4.9104e1	-4.9104e1	-4.9102e1	-4.9387e1	-4.9365e1
-4.8802e1	-4.8784e1	-4.8768e1	-5.038e1	-5.0427e1	-5.0478e1	-5.0531e1	-5.19e1	-5.1965e1	-5.2027e1
-5.2085e1	-5.2139e1	-5.2187e1	-5.223e1	-5.2267e1	-5.23e1	-5.2329e1	-5.3419e1	-5.4571e1	-5.4592e1
-4.909e1	-4.9094e1	-4.9097e1	-4.9101e1	-4.9103e1	-4.9105e1	-4.9105e1	-4.9103e1	-4.9393e1	-4.9375e1
-4.8809e1	-4.8793e1	-4.8779e1	-5.0411e1	-5.0452e1	-5.0496e1	-5.0542e1	-5.0589e1	-5.1969e1	-5.2024e1
-5.2076e1	-5.2124e1	-5.2168e1	-5.2209e1	-5.2245e1	-5.2276e1	-5.2304e1	-5.2329e1	-5.3422e1	-5.4577e1

11 1. (10G11.4) -1 Vcont Layer - 3

1.5089e-2	1.5266e-2	1.5471e-2	1.5685e-2	1.5887e-2	1.6051e-2	1.5516e-2	1.5171e-2	1.338e-2	8.7516e-3
8.2033e-3	6.5967e-3	6.3031e-3	6.1336e-3	6.0553e-3	6.1033e-3	6.492e-3	6.8545e-3	7.042e-3	7.1191e-3
7.1434e-3	7.1455e-3	7.045e-3	7.5915e-3	7.583e-3	7.5764e-3	7.5709e-3	7.5665e-3	7.5625e-3	7.5596e-3
1.7533e-3	1.7779e-3	1.8076e-3	1.8404e-3	1.872e-3	1.8974e-3	1.8559e-3	1.8107e-3	1.7347e-3	1.0343e-3
9.5797e-4	8.8902e-4	7.3126e-4	6.7444e-4	6.5722e-4	6.8899e-4	7.7528e-4	8.2928e-4	8.4649e-4	8.4859e-4
8.4634e-4	8.8976e-4	8.8802e-4	8.8663e-4	8.8559e-4	8.8473e-4	8.8408e-4	8.8361e-4	8.8318e-4	8.8279e-4
1.7342e-3	1.7616e-3	1.7983e-3	1.8416e-3	1.8856e-3	1.9207e-3	1.9054e-3	1.8584e-3	1.762e-3	1.1718e-3
9.6021e-4	8.9371e-4	7.5189e-4	6.6999e-4	6.3471e-4	6.9983e-4	8.2273e-4	8.7221e-4	8.7397e-4	8.9608e-4
8.9234e-4	8.8954e-4	8.8758e-4	8.8611e-4	8.8507e-4	8.843e-4	8.8369e-4	8.8322e-4	8.8283e-4	8.8249e-4
1.4469e-3	1.7327e-3	1.7756e-3	1.8336e-3	1.897e-3	1.9479e-3	2.0079e-3	1.9175e-3	1.7987e-3	1.1493e-3
9.5717e-4	9.0825e-4	8.1444e-4	7.3991e-4	7.0358e-4	7.7931e-4	8.7368e-4	9.0799e-4	9.0298e-4	8.9603e-4
8.9137e-4	8.8845e-4	8.8654e-4	8.8529e-4	8.8438e-4	8.8369e-4	8.8318e-4	8.8275e-4	8.8802e-4	8.8819e-4
1.4089e-3	1.428e-3	1.7278e-3	1.8012e-3	1.8958e-3	1.9749e-3	2.0195e-3	2.0119e-3	1.8375e-3	1.1176e-3
9.7131e-4	9.1277e-4	8.7822e-4	8.3521e-4	7.7488e-4	9.1738e-4	8.9427e-4	9.0388e-4	8.9816e-4	8.9203e-4
8.8845e-4	8.8633e-4	8.8499e-4	8.8408e-4	8.8339e-4	8.8292e-4	8.8789e-4	8.8824e-4	8.885e-4	8.8872e-4
1.2705e-3	1.3696e-3	1.3889e-3	1.4537e-3	1.8474e-3	1.99e-3	2.0265e-3	2.0146e-3	1.8382e-3	1.0899e-3
9.2079e-4	9.068e-4	9.0018e-4	9.1392e-4	9.0161e-4	8.9702e-4	8.928e-4	8.9075e-4	8.8439e-4	8.8456e-4
8.8404e-4	8.8348e-4	8.8301e-4	8.8262e-4	8.8228e-4	8.8798e-4	8.8859e-4	8.8893e-4	8.892e-4	8.8933e-4
1.2571e-3	1.2482e-3	1.2396e-3	1.3113e-3	1.404e-3	1.9132e-3	2.0059e-3	1.9747e-3	1.6373e-3	9.9546e-4
9.3262e-4	9.0734e-4	9.0635e-4	9.1563e-4	8.9208e-4	8.9942e-4	8.9125e-4	8.8346e-4	8.8405e-4	8.8431e-4
8.7963e-4	8.8052e-4	8.8091e-4	8.7622e-4	8.7728e-4	8.78e-4	8.7843e-4	8.7868e-4	8.7872e-4	8.7872e-4
1.2496e-3	1.2355e-3	1.2157e-3	1.1955e-3	1.2245e-3	1.3571e-3	1.6416e-3	1.5417e-3	1.505e-3	1.3328e-3
9.7513e-4	9.0499e-4	9.0495e-4	9.1883e-4	9.012e-4	8.8967e-4	8.7996e-4	8.7881e-4	8.8194e-4	8.8327e-4
8.8387e-4	8.8426e-4	8.9813e-4	8.8976e-4	8.9933e-4	8.9973e-4	8.9995e-4	9.0009e-4	9.0004e-4	9.0004e-4
1.1834e-3	1.1906e-3	1.1819e-3	1.2258e-3	1.1921e-3	1.2475e-3	1.562e-3	1.5117e-3	1.4381e-3	1.3643e-3
1.1833e-3	8.9943e-4	9.0059e-4	9.4786e-4	9.6354e-4	9.39e-4	8.7455e-4	8.7667e-4	8.8063e-4	8.8231e-4
8.9045e-4	8.9387e-4	8.9595e-4	8.9697e-4	8.9732e-4	8.924e-4	8.9253e-4	9.0059e-4	9.0046e-4	9.0028e-4
1.1864e-3	1.2057e-3	1.2307e-3	1.2535e-3	1.2369e-3	1.3099e-3	1.7422e-3	1.5558e-3	1.4529e-3	1.2861e-3
9.9498e-4	9.122e-4	9.1754e-4	9.5767e-4	9.7637e-4	9.7826e-4	9.3916e-4	9.1574e-4	9.089e-4	8.9277e-4
8.9843e-4	9.0137e-4	9.0205e-4	9.016e-4	9.0084e-4	8.9999e-4	8.9923e-4	9.0492e-4	8.9297e-4	8.9271e-4
1.1804e-3	1.2103e-3	1.2838e-3	1.3391e-3	1.3987e-3	1.5887e-3	1.6012e-3	1.4787e-3	1.4807e-3	1.0878e-3
9.4817e-4	9.0069e-4	9.557e-4	9.5706e-4	9.9489e-4	9.8597e-4	9.652e-4	9.5432e-4	9.4873e-4	9.4992e-4
9.5116e-4	9.1952e-4	9.0969e-4	9.0701e-4	9.0466e-4	9.0281e-4	9.0138e-4	9.0017e-4	8.9928e-4	8.9847e-4
1.1012e-3	1.12e-3	1.2047e-3	1.2194e-3	1.2412e-3	2.1384e-3	1.4801e-3	1.2161e-3	1.0918e-3	9.5588e-4
9.3983e-4	9.3283e-4	1.078e-3	1.1895e-3	1.0527e-3	1.0098e-3	1.0047e-3	1.0189e-3	9.636e-4	9.6636e-4
9.6487e-4	9.6012e-4	9.5622e-4	9.2054e-4	9.1664e-4	9.0538e-4	9.033e-4	9.0173e-4	9.0048e-4	8.995e-4
1.1068e-3	1.1348e-3	1.0903e-3	1.0037e-3	9.774e-4	1.4274e-3	9.6599e-4	1.1149e-3	9.2654e-4	9.3025e-4
9.6564e-4	1.0999e-3	1.5132e-3	1.6095e-3	1.2722e-3	1.1431e-3	1.1264e-3	1.0356e-3	1.0605e-3	1.0723e-3
9.7389e-4	9.6672e-4	9.6058e-4	9.5677e-4	9.5366e-4	9.5316e-4	9.1442e-4	9.2211e-4	9.1412e-4	9.0035e-4
1.0982e-3	1.0688e-3	1.0164e-3	9.5883e-4	9.0906e-4	1.3042e-3	1.1531e-3	9.0512e-4	8.9334e-4	9.0262e-4
9.4685e-4	1.2446e-3	1.5257e-3	1.5198e-3	1.3528e-3	1.3085e-3	1.0101e-3	1.076e-3	1.12e-3	1.1619e-3
1.1001e-3	1.0917e-3	1.0845e-3	1.0793e-3	9.5576e-4	9.5331e-4	9.5151e-4	9.5211e-4	9.1254e-4	9.1116e-4
1.1124e-3	1.0957e-3	1.0654e-3	1.0419e-3	9.903e-4	1.067e-3	9.7448e-4	8.7154e-4	8.971e-4	8.9057e-4
1.076e-3	1.3907e-3	1.4185e-3	1.3184e-3	1.2396e-3	1.2403e-3	1.253e-3	1.2267e-3	1.0967e-3	1.1334e-3
1.1438e-3	1.1314e-3	1.1337e-3	1.0941e-3	1.0885e-3	1.0844e-3	1.0815e-3	9.5126e-4	9.5016e-4	9.5136e-4
1.1432e-3	1.0924e-3	1.142e-3	1.1775e-3	1.1585e-3	1.059e-3	9.5811e-4	8.9108e-4	8.8678e-4	9.6582e-4
1.2739e-3	1.6628e-3	1.4691e-3	1.2845e-3	1.1611e-3	1.2302e-3	1.236e-3	1.3163e-3	1.3962e-3	1.3116e-3
1.117e-3	1.1126e-3	1.1016e-3	1.0895e-3	1.0785e-3	1.029e-3	1.0279e-3	1.0193e-3	1.0847e-3	1.0827e-3
1.0654e-3	1.112e-3	1.212e-3	1.4515e-3	1.3317e-3	1.147e-3	9.4985e-4	9.2393e-4	9.3051e-4	9.9947e-4
1.4192e-3	1.7298e-3	1.5438e-3	1.307e-3	1.2148e-3	1.247e-3	1.279e-3	1.3522e-3	1.4176e-3	1.4084e-3
1.2958e-3	1.3042e-3	1.09e-3	1.0822e-3	1.0742e-3	1.0669e-3	1.0604e-3	1.0232e-3	1.0183e-3	1.0143e-3
1.0407e-3	1.0489e-3	1.1277e-3	1.2329e-3	1.1182e-3	9.6418e-4	9.0702e-4	8.9795e-4	9.569e-4	1.126e-3
1.3819e-3	1.374e-3	1.3419e-3	1.4846e-3	1.3065e-3	1.2925e-3	1.3179e-3	1.3324e-3	1.4257e-3	1.4764e-3
1.5213e-3	1.5542e-3	1.2809e-3	1.2784e-3	1.3059e-3	1.0638e-3	1.0586e-3	1.054e-3	1.0119e-3	1.0154e-3
9.6889e-4	9.6914e-4	9.5371e-4	8.8133e-4	8.0064e-4	7.9353e-4	8.5957e-4	9.0806e-4	1.0522e-3	1.1685e-3
1.3115e-3	1.1891e-3	1.1146e-3	1.1146e-3	1.2551e-3	1.1838e-3	1.1902e-3	1.1932e-3	1.4448e-3	1.4773e-3
1.5088e-3	1.5341e-3	1.5527e-3	1.5655e-3	1.2635e-3	1.2599e-3	1.2557e-3	1.0525e-3	1.049e-3	1.0458e-3
9.2653e-4	8.9939e-4	8.3926e-4	7.5993e-4	6.8868e-4	7.0591e-4	8.0061e-4	9.2673e-4	1.0997e-3	1.1231e-3
1.215e-3	1.0592e-3	1.025e-3	1.0878e-3	1.1819e-3	1.2516e-3	1.1788e-3	1.1853e-3	1.1888e-3	1.264e-3
1.2908e-3	1.3138e-3	1.331e-3	1.5526e-3	1.5605e-3	1.5646e-3	1.5667e-3	1.2474e-3	1.2442e-3	1.045e-3

8.5429e-4	8.3823e-4	8.1693e-4	7.5726e-4	7.1835e-4	7.5033e-4	8.1621e-4	8.5236e-4	9.0189e-4	1.0869e-3
1.2003e-3	1.1355e-3	1.0836e-3	1.098e-3	1.0284e-3	1.2039e-3	1.2234e-3	1.1775e-3	1.1828e-3	1.2469e-3
1.2702e-3	1.2905e-3	1.3069e-3	1.3194e-3	1.3281e-3	1.3336e-3	1.3366e-3	1.5617e-3	1.562e-3	1.5615e-3
8.4831e-4	8.5359e-4	8.2018e-4	7.8586e-4	7.7557e-4	7.9289e-4	8.3067e-4	8.485e-4	9.3557e-4	9.9069e-4
1.2153e-3	1.188e-3	1.1187e-3	1.1154e-3	1.1133e-3	1.2699e-3	1.2175e-3	1.2286e-3	1.1618e-3	1.2354e-3
1.2546e-3	1.2725e-3	1.2883e-3	1.3005e-3	1.3098e-3	1.3165e-3	1.3209e-3	1.3235e-3	1.3247e-3	1.325e-3
7.1952e-3	7.3128e-3	7.1252e-3	8.137e-4	8.1972e-4	8.2799e-4	8.5038e-4	8.523e-4	9.2981e-4	9.7404e-4
1.2318e-3	1.2191e-3	1.1359e-3	1.1284e-3	1.1231e-3	1.1098e-3	1.2908e-3	1.3018e-3	1.2328e-3	1.1618e-3
1.2442e-3	1.2594e-3	1.2734e-3	1.2857e-3	1.295e-3	1.3022e-3	1.3076e-3	1.3112e-3	1.3136e-3	1.315e-3
7.3529e-3	7.372e-3	7.2497e-3	8.5212e-4	8.4798e-4	8.5356e-4	8.3604e-4	8.5782e-4	9.2748e-4	9.6228e-4
1.0711e-3	1.2389e-3	1.1448e-3	1.137e-3	1.1308e-3	1.0352e-3	1.2942e-3	1.3032e-3	1.3102e-3	1.2361e-3
1.3314e-3	1.2504e-3	1.2632e-3	1.2733e-3	1.2825e-3	1.2904e-3	1.2961e-3	1.3005e-3	1.3036e-3	1.3058e-3
7.5166e-3	7.4297e-3	7.5395e-3	8.6981e-4	8.6789e-4	8.7194e-4	8.4746e-4	9.0962e-4	9.271e-4	9.5497e-4
1.0624e-3	1.2522e-3	1.1499e-3	1.1428e-3	1.1367e-3	1.038e-3	1.1176e-3	1.3059e-3	1.3117e-3	1.3165e-3
1.2391e-3	1.3411e-3	1.2545e-3	1.2649e-3	1.2727e-3	1.28e-3	1.2865e-3	1.2912e-3	1.2949e-3	1.2976e-3
7.5473e-3	7.6893e-3	7.599e-3	8.8327e-4	8.8241e-4	8.6981e-4	8.561e-4	9.1734e-4	9.2767e-4	9.4997e-4
1.0556e-3	1.0726e-3	1.1534e-3	1.1471e-3	1.1416e-3	1.1367e-3	1.12e-3	1.1208e-3	1.3137e-3	1.3178e-3
1.3217e-3	1.4435e-3	1.3483e-3	1.2573e-3	1.2656e-3	1.2727e-3	1.2784e-3	1.2836e-3	1.2875e-3	1.2906e-3
7.7957e-3	7.7487e-3	7.6739e-3	8.9358e-4	8.7695e-4	8.7929e-4	8.6269e-4	9.236e-4	9.2872e-4	9.4674e-4
1.0507e-3	1.0664e-3	1.1553e-3	1.1498e-3	1.1449e-3	1.1404e-3	1.0376e-3	1.1225e-3	1.3164e-3	1.3195e-3
1.323e-3	1.4399e-3	1.4539e-3	1.3537e-3	1.2592e-3	1.2659e-3	1.2718e-3	1.2767e-3	1.2808e-3	1.2842e-3
7.8338e-3	7.762e-3	7.7354e-3	7.7207e-3	7.5756e-3	7.5907e-3	7.4311e-3	7.9516e-3	7.9498e-3	8.0761e-3
8.9508e-3	9.0698e-3	9.8793e-3	9.8387e-3	9.8008e-3	9.767e-3	8.8813e-3	9.6256e-3	9.6262e-3	1.1312e-2
1.1334e-2	1.1354e-2	1.2411e-2	1.251e-2	1.1619e-2	1.0787e-2	1.0836e-2	1.0877e-2	1.0912e-2	1.0942e-2
7.8691e-3	7.8044e-3	7.7861e-3	7.6253e-3	7.6268e-3	7.6392e-3	7.8911e-3	7.9871e-3	7.9728e-3	8.0784e-3
8.9499e-3	9.0552e-3	9.1468e-3	9.8723e-3	9.8386e-3	9.7866e-3	9.7583e-3	9.6375e-3	9.6369e-3	1.1328e-2
1.1347e-2	1.1364e-2	1.239e-2	1.248e-2	1.2563e-2	1.1645e-2	1.0794e-2	1.0835e-2	1.087e-2	1.0899e-2
7.8601e-3	7.8414e-3	7.6716e-3	7.6655e-3	7.6678e-3	7.6776e-3	7.9366e-3	8.0168e-3	7.9826e-3	8.0717e-3
8.9381e-3	9.0315e-3	9.1141e-3	9.881e-3	9.851e-3	9.823e-3	9.7976e-3	8.8904e-3	9.6465e-3	9.6465e-3
1.136e-2	1.1374e-2	1.1389e-2	1.2459e-2	1.2536e-2	1.2607e-2	1.1665e-2	1.0799e-2	1.0833e-2	1.0863e-2
7.8868e-3	7.8728e-3	7.7031e-3	7.6989e-3	7.7008e-3	7.7088e-3	7.9736e-3	8.0416e-3	7.9921e-3	8.0679e-3
8.9303e-3	9.0137e-3	9.0885e-3	8.3549e-3	9.8616e-3	9.836e-3	9.813e-3	8.8975e-3	9.6555e-3	9.6543e-3
1.1374e-2	1.1386e-2	1.1398e-2	1.2444e-2	1.2515e-2	1.2581e-2	1.264e-2	1.168e-2	1.08e-2	1.083e-2
7.9108e-3	7.7357e-3	7.7292e-3	7.7265e-3	7.7284e-3	8.1981e-3	8.5807e-3	8.0629e-3	8.0007e-3	8.0658e-3
8.9267e-3	9.0006e-3	9.0683e-3	8.3253e-3	9.8697e-3	9.8472e-3	9.826e-3	9.6301e-3	9.6626e-3	9.6615e-3
9.6603e-3	1.1397e-2	1.1408e-2	1.1417e-2	1.2499e-2	1.256e-2	1.2616e-2	1.2668e-2	1.1691e-2	1.0801e-2

11 1. (10G11.4) -1 Aquifer Top - 3

-4.1131e1	-4.1305e1	-4.15e1	-4.1698e1	-4.188e1	-4.2024e1	-4.2754e1	-4.2691e1	-4.1573e1	-3.9497e1
-3.8908e1	-3.8267e1	-3.7424e1	-3.711e1	-3.7234e1	-3.9352e1	-4.1254e1	-4.2497e1	-4.3108e1	-4.3378e1
-4.3493e1	-4.3539e1	-4.3263e1	-4.488e1	-4.488e1	-4.488e1	-4.488e1	-4.4879e1	-4.4878e1	-4.4878e1
-4.1028e1	-4.1235e1	-4.1478e1	-4.1736e1	-4.1977e1	-4.2164e1	-4.2815e1	-4.2747e1	-4.2624e1	-3.977e1
-3.9171e1	-3.8247e1	-3.7048e1	-3.5406e1	-3.5305e1	-3.8472e1	-4.1711e1	-4.3194e1	-4.366e1	-4.3772e1
-4.3779e1	-4.488e1	-4.4882e1	-4.4882e1	-4.4882e1	-4.4881e1	-4.488e1	-4.488e1	-4.4879e1	-4.4878e1
-4.0863e1	-4.1099e1	-4.1402e1	-4.1746e1	-4.2078e1	-4.2332e1	-4.2886e1	-4.2819e1	-4.2669e1	-4.1955e1
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-4.4879e1	-4.4883e1	-4.4885e1	-4.4884e1	-4.4883e1	-4.4882e1	-4.4881e1	-4.488e1	-4.4879e1	-4.4878e1
-3.7224e1	-4.085e1	-4.1216e1	-4.1683e1	-4.2162e1	-4.2523e1	-4.3149e1	-4.2903e1	-4.2728e1	-4.1868e1
-4.0119e1	-3.9751e1	-3.8997e1	-3.7212e1	-3.7559e1	-4.1529e1	-4.4191e1	-4.4805e1	-4.4846e1	-4.4876e1
-4.4887e1	-4.4889e1	-4.4888e1	-4.4887e1	-4.4885e1	-4.4883e1	-4.4882e1	-4.488e1	-4.5009e1	-4.5018e1
-3.673e1	-3.6982e1	-4.0807e1	-4.1426e1	-4.2153e1	-4.2707e1	-4.3085e1	-4.3127e1	-4.2788e1	-4.174e1
-4.1041e1	-4.0432e1	-4.0258e1	-3.9667e1	-4.1374e1	-4.5037e1	-4.4905e1	-4.4865e1	-4.4891e1	-4.4904e1
-4.4902e1	-4.4897e1	-4.4892e1	-4.4889e1	-4.4886e1	-4.4884e1	-4.5006e1	-4.502e1	-4.503e1	-4.5039e1
-3.4233e1	-3.6191e1	-3.6461e1	-3.7311e1	-4.179e1	-4.2786e1	-4.3046e1	-4.3112e1	-4.2312e1	-4.1622e1
-4.0648e1	-4.0641e1	-4.0613e1	-4.1487e1	-4.4077e1	-4.4806e1	-4.4969e1	-4.5229e1	-4.5021e1	-4.4944e1
-4.4916e1	-4.4903e1	-4.4895e1	-4.489e1	-4.4886e1	-4.5022e1	-4.5038e1	-4.5049e1	-4.5057e1	-4.5062e1
-3.391e1	-3.3871e1	-3.3868e1	-3.5332e1	-3.6663e1	-4.2208e1	-4.3161e1	-4.3341e1	-4.3016e1	-4.0569e1
-4.0634e1	-4.0601e1	-4.0789e1	-4.1666e1	-4.4886e1	-4.4781e1	-4.4862e1	-4.5152e1	-4.5076e1	-4.5062e1
-4.4916e1	-4.4902e1	-4.4894e1	-4.5026e1	-4.505e1	-4.5067e1	-4.5078e1	-4.5085e1	-4.5088e1	-4.509e1
-3.3634e1	-3.3515e1	-3.3381e1	-3.3241e1	-3.3891e1	-3.6002e1	-4.3091e1	-4.3095e1	-4.2978e1	-4.2726e1
-4.0585e1	-4.0571e1	-4.0561e1	-4.1995e1	-4.4953e1	-4.4969e1	-4.5152e1	-4.5067e1	-4.5079e1	-4.5079e1
-4.5073e1	-4.5067e1	-4.5236e1	-4.54e1	-4.5603e1	-4.5603e1	-4.5602e1	-4.5601e1	-4.5598e1	-4.5596e1
-3.2834e1	-3.283e1	-3.3063e1	-3.297e1	-3.3193e1	-3.515e1	-4.2209e1	-4.3319e1	-4.2715e1	-4.2796e1
-4.2347e1	-4.044e1	-4.0426e1	-4.4654e1	-4.5457e1	-4.5582e1	-4.5888e1	-4.5455e1	-4.5187e1	-4.5118e1
-4.526e1	-4.5313e1	-4.5344e1	-4.5355e1	-4.5355e1	-4.5476e1	-4.5467e1	-4.5641e1	-4.5632e1	-4.5624e1
-3.2787e1	-3.2722e1	-3.2636e1	-3.2906e1	-3.3244e1	-3.3844e1	-4.2658e1	-4.3034e1	-4.2957e1	-4.2664e1
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-3.2046e1	-3.2061e1	-3.2577e1	-3.3209e1	-3.4664e1	-3.8988e1	-3.8633e1	-3.8058e1	-3.7284e1	-3.8657e1
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-4.6248e1	-4.6168e1	-4.6086e1	-4.6025e1	-4.598e1	-4.5982e1	-4.5655e1	-4.5617e1	-4.5442e1	-4.5412e1
-3.304e1	-3.2892e1	-3.2605e1	-3.2175e1	-2.936e1	-3.7511e1	-3.7111e1	-3.5178e1	-3.6255e1	-3.687e1
-3.7927e1	-4.1445e1	-4.3235e1	-4.3295e1	-4.2402e1	-4.2222e1	-4.3079e1	-4.448e1	-4.5286e1	-4.5931e1
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-3.325e1	-3.3171e1	-3.294e1	-3.2685e1	-3.2163e1	-3.4885e1	-3.5073e1	-3.4247e1	-3.5723e1	-3.7467e1
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-3.0896e1	-3.062e1	-3.0006e1	-2.7961e1	-2.6144e1	-2.7108e1	-2.9189e1	-3.0723e1	-3.2422e1	-3.3692e1
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-3.8453e1  -3.8546e1  -3.9771e1  -3.9919e1  -4.0048e1   -4.016e1  -4.0256e1  -4.0338e1  -4.0407e1  -4.0465e1
-2.9232e1  -2.9175e1  -2.9136e1  -2.8723e1  -2.8734e1  -2.8771e1  -2.9421e1  -2.9655e1  -2.9891e1  -3.0115e1
-3.1433e1  -3.1612e1  -3.1763e1  -3.4576e1  -3.4586e1  -3.4606e1  -3.4634e1  -3.5769e1  -3.5855e1  -3.8344e1
-3.8439e1  -3.8524e1  -3.9712e1   -3.985e1  -3.9973e1  -4.0081e1  -4.0175e1  -4.0257e1  -4.0327e1  -4.0386e1
-2.9316e1  -2.9275e1  -2.8843e1  -2.8833e1  -2.8843e1  -2.8872e1  -2.9533e1  -2.9727e1  -2.9923e1  -3.0112e1
 -3.142e1   -3.158e1  -3.1718e1  -3.4632e1  -3.4639e1  -3.4653e1  -3.4674e1  -3.4421e1  -3.5867e1  -3.5937e1
-3.8434e1   -3.851e1  -3.8579e1  -3.9797e1  -3.9913e1  -4.0016e1  -4.0107e1  -4.0187e1  -4.0256e1  -4.0317e1
 -2.939e1  -2.9359e1  -2.8929e1  -2.8923e1  -2.8931e1  -2.8954e1  -2.9624e1  -2.9787e1  -2.9953e1  -3.0114e1
-3.1414e1  -3.1557e1  -3.1683e1  -3.1793e1  -3.4684e1  -3.4694e1   -3.471e1  -3.4445e1  -3.5882e1  -3.5942e1
-3.8435e1  -3.8504e1  -3.8566e1  -3.9756e1  -3.9864e1  -3.9962e1  -4.0049e1  -4.0127e1  -4.0195e1  -4.0256e1
-2.9455e1  -2.9014e1     -2.9e1  -2.8997e1  -2.9004e1  -3.0159e1  -3.1005e1  -2.9839e1   -2.998e1  -3.0119e1
-3.1414e1  -3.1541e1  -3.1656e1  -3.1758e1  -3.4722e1   -3.473e1  -3.4742e1  -3.4467e1  -3.5898e1  -3.5951e1
-3.6001e1  -3.8502e1  -3.8559e1  -3.8611e1  -3.9826e1  -3.9918e1  -4.0001e1  -4.0076e1  -4.0143e1  -4.0202e1
       11         1. (10G11.4)               -1 Conductivity Layer - 4
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11	1. (10G11.4)			-1 Aquifer Bottom - 4					
-8.4544e1	-8.4608e1	-8.4679e1	-8.4752e1	-8.4818e1	-8.4871e1	-8.5654e1	-8.5744e1	-8.5884e1	-8.5681e1
-8.6104e1	-9.1132e1	-9.1806e1	-9.2778e1	-9.3972e1	-9.5273e1	-9.5687e1	-9.5864e1	-9.5797e1	-9.5548e1
-9.5233e1	-9.4933e1	-9.4681e1	-9.448e1	-9.4323e1	-9.4201e1	-9.4105e1	-9.4029e1	-9.3968e1	-9.3919e1
-8.4506e1	-8.4582e1	-8.4671e1	-8.4766e1	-8.4854e1	-8.4922e1	-8.5569e1	-8.5665e1	-8.5838e1	-8.5731e1
-8.6294e1	-8.6679e1	-9.125e1	-9.2434e1	-9.4034e1	-9.5529e1	-9.6203e1	-9.6515e1	-9.6337e1	-9.5865e1
-9.5364e1	-9.4954e1	-9.4648e1	-9.4425e1	-9.4262e1	-9.4141e1	-9.4049e1	-9.3978e1	-9.3922e1	-9.3877e1
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-8.6577e1	-8.7019e1	-9.0471e1	-9.1825e1	-9.392e1	-9.5684e1	-9.6896e1	-9.7535e1	-9.7035e1	-9.612e1
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-9.5094e1	-9.4603e1	-9.4318e1	-9.4141e1	-9.4023e1	-9.3941e1	-9.3881e1	-9.3835e1	-9.38e1	-9.3772e1
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-8.7614e1	-8.8071e1	-8.825e1	-8.9086e1	-9.2391e1	-9.2476e1	-9.0592e1	-8.7705e1	-9.197e1	-9.316e1
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-9.2798e1	-9.3151e1	-9.3334e1	-9.5102e1	-9.5176e1	-9.5226e1	-9.5262e1	-9.5288e1	-9.5308e1	-9.5324e1
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11	1. (10G11.4)			-1 Aquifer Top - 4					
-5.1405e1	-5.1459e1	-5.1519e1	-5.158e1	-5.1636e1	-5.168e1	-5.2744e1	-5.2909e1	-5.3164e1	-5.7239e1
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4	26	27	2.4388e-3
3	20	5	-7.757e3

Appendix F.3 Aquifer and aquitard parameter arrays.

```
         1        50-1.00e+030        0 1.00e+000          1          0
 3 3 3 3 3
        11 1.00e+000(10G11.4)                   -1 Anisotropy factor(s)
        1.         1.         1.         1.         1.
        11 1.00e+000(10G11.4)                   -1 cell column delta
   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2
   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2
   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2   5.1052e2
         0 5.05e+002(10G11.4)                   -1 cell row delta
        11         1. (10G11.4)                 -1 Conductivity Layer - 0
   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2
   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2
   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2
   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2
   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3
    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3
   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2
   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3
    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3
   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2
   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2    8.64e-3    8.64e-3    8.64e-3    8.64e-3
    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3
   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2
   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2    8.64e-3    8.64e-3    8.64e-3    8.64e-3
    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3
   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2
   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2    8.64e-3    8.64e-3    8.64e-3    8.64e-3
    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3
   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2
   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2    8.64e-3    8.64e-3    8.64e-3
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   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2   7.776e-2    8.64e-3    8.64e-3    8.64e-3
    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3    8.64e-3
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        11         1. (10G11.4)                 -1 Aquifer Bottom - 0
   -3.7554    -3.7719    -3.7902     -3.809    -3.8263      -3.84    -4.5124    -4.6388    -4.4027    -7.8228
```

-7.931	-8.404	-8.0567	-7.8046	-7.7904	-8.5411	-9.1058	-9.4691	-9.6702	-9.7985
-9.8935	-9.967	-1.0144e1	-1.0993e1	-1.1049e1	-1.1095e1	-1.1132e1	-1.1163e1	-1.1187e1	-1.1208e1
-3.7458	-3.7651	-3.7882	-3.8126	-3.8356	-3.8532	-4.3925	-4.5278	-4.77	-7.9048
-8.0913	-8.0201	-7.9406	-7.3032	-7.198	-8.2319	-9.1737	-9.5743	-9.7427	-9.8604
-9.9567	-1.082e1	-1.0925e1	-1.1005e1	-1.1065e1	-1.1112e1	-1.1149e1	-1.1178e1	-1.1202e1	-1.1222e1
-3.7298	-3.7522	-3.7811	-3.8135	-3.8452	-3.8692	-4.2515	-4.385	-4.6806	-7.4581
-8.3593	-8.344	-8.1196	-7.1645	-6.8861	-8.3475	-9.4471	-9.6812	-9.7898	-1.0438e1
-1.067e1	-1.0837e1	-1.0953e1	-1.1035e1	-1.1094e1	-1.1139e1	-1.1173e1	-1.12e1	-1.1221e1	-1.1239e1
-3.2227	-3.7288	-3.7633	-3.8075	-3.853	-3.8874	-4.0529	-4.2189	-4.5643	-7.5981
-8.7287	-8.8513	-8.9047	-8.0159	-8.003	-9.2437	-9.712	-9.6629	-1.0011e1	-1.0452e1
-1.0736e1	-1.0907e1	-1.1015e1	-1.1088e1	-1.1138e1	-1.1176e1	-1.1204e1	-1.1226e1	-1.1265e1	-1.1288e1
-3.1748	-3.1995	-3.7245	-3.7832	-3.8522	-3.9047	-3.9807	-4.0276	-4.4464	-7.8055
-8.9376	-9.3208	-9.4113	-9.2134	-1.0084e1	-1.081e1	-1.0622e1	-9.9923	-1.0354e1	-1.0723e1
-1.0924e1	-1.1039e1	-1.1111e1	-1.116e1	-1.1195e1	-1.1221e1	-1.1259e1	-1.1288e1	-1.131e1	-1.1328e1
-2.7058	-3.1223	-3.1489	-3.2318	-3.8177	-3.902	-3.9373	-4.0115	-4.2256	-7.9964
-9.3886	-9.5408	-9.5412	-9.9362	-1.1715e1	-1.1887e1	-1.1963e1	-1.1899e1	-1.1341e1	-1.1209e1
-1.1197e1	-1.1212e1	-1.1229e1	-1.1246e1	-1.126e1	-1.1302e1	-1.1327e1	-1.1346e1	-1.1361e1	-1.1372e1
-2.652	-2.6918	-2.7464	-3.0392	-3.1673	-3.8243	-4.0658	-4.2667	-6.3401	-8.5844
-9.2512	-9.4893	-9.5601	-1.0018e1	-1.2142e1	-1.204e1	-1.2257e1	-1.22e1	-1.2221e1	-1.2233e1
-1.145e1	-1.1381e1	-1.1348e1	-1.136e1	-1.1377e1	-1.1392e1	-1.1402e1	-1.141e1	-1.1415e1	-1.1419e1
-1.7514	-2.6217	-2.6967	-2.7744	-2.8945	-3.0981	-6.3541	-6.7047	-6.784	-7.1413
-8.7865	-9.1635	-9.139	-1.0167e1	-1.1958e1	-1.219e1	-1.2356e1	-1.2336e1	-1.2281e1	-1.2262e1
-1.2254e1	-1.225e1	-1.2273e1	-1.2087e1	-1.1405e1	-1.14e1	-1.1395e1	-1.139e1	-1.1385e1	-1.1379e1
-1.5858	-1.8492	-2.2346	-2.7032	-2.7797	-3.4652	-6.4686	-6.858	-6.9029	-6.9232
-7.0078	-8.3411	-8.4462	-1.0106e1	-1.0842e1	-1.1305e1	-1.2567e1	-1.2457e1	-1.2333e1	-1.229e1
-1.2295e1	-1.2297e1	-1.2298e1	-1.2298e1	-1.2296e1	-1.2129e1	-1.2116e1	-1.1465e1	-1.1448e1	-1.1433e1
-1.2915	-1.4674	-1.678	-2.0209	-2.6511	-2.7612	-6.4788	-6.8036	-6.9004	-6.9506
-7.2335	-7.3218	-8.2474	-9.5225	-1.0347e1	-1.0539e1	-1.1175e1	-1.1574e1	-1.1657e1	-1.2337e1
-1.2336e1	-1.2334e1	-1.2329e1	-1.2322e1	-1.2314e1	-1.2308e1	-1.2303e1	-1.2298e1	-1.2127e1	-1.2117e1
-8.8055e-1	-9.3424e-1	-1.1162	-1.2719	-1.1084	-2.6236	-4.9486	-5.9995	-6.5852	-7.1402
-7.3949	-7.4479	-7.7189	-9.2061	-1.0185e1	-1.0401e1	-1.0602e1	-1.108e1	-1.1446e1	-1.1758e1
-1.1915e1	-1.2368e1	-1.2362e1	-1.2346e1	-1.2333e1	-1.2322e1	-1.2314e1	-1.2307e1	-1.2301e1	-1.2296e1
4.2383e-1	4.4794e-1	5.5847e-1	1.4784	1.3131	-3.0059	-4.5374	-5.0241	-5.4574	-6.6271
-7.3052	-7.5647	-7.5273	-8.1865	-9.2906	-1.0002e1	-1.0245e1	-1.0725e1	-1.1633e1	-1.2114e1
-1.2239e1	-1.2126e1	-1.1981e1	-1.2353e1	-1.2338e1	-1.2335e1	-1.2323e1	-1.2314e1	-1.2307e1	-1.2301e1
3.1141e-1	6.5203e-1	1.07	2.6114	3.2564	-2.9761	-4.8627	-5.2706	-6.1637	-6.4536
-6.8343	-7.058	-7.0054	-6.9946	-8.0085	-8.9453	-9.7305	-1.054e1	-1.1625e1	-1.2378e1
-1.2437e1	-1.2248e1	-1.2053e1	-1.1907e1	-1.1802e1	-1.1954e1	-1.2315e1	-1.2308e1	-1.2313e1	-1.2306e1
-2.6503e-3	-1.2434e-2	-9.3407e-1	-1.5144	-1.1112	-4.4104	-4.9377	-6.0691	-6.5625	-5.8569
-6.3262	-7.748	-7.7149	-7.4655	-7.0077	-7.1807	-8.458	-1.0482e1	-1.1235e1	-1.2048e1
-1.2279e1	-1.2204e1	-1.2039e1	-1.1905e1	-1.1803e1	-1.1728e1	-1.167e1	-1.1884e1	-1.2298e1	-1.2294e1
-1.451	-1.5172	-2.1232	-2.0607	-2.1058	-3.3034	-5.1344	-5.9236	-5.7243	-5.1576
-5.663	-7.289	-9.1829	-8.9083	-8.4072	-8.0223	-7.9717	-8.9201	-1.0256e1	-1.1115e1
-1.1439e1	-1.1345e1	-1.1563e1	-1.1861e1	-1.1779e1	-1.1713e1	-1.1661e1	-1.1619e1	-1.1586e1	-1.1837e1
-1.6499	-1.8203	-2.1145	-2.7827	-2.7489	-3.3088	-3.6824	-3.3514	-3.6752	-4.4333
-6.1756	-6.4638	-8.8259	-8.641	-8.0975	-8.2918	-8.3983	-8.6635	-9.3445	-1.003e1
-1.0668e1	-1.0764e1	-1.0698e1	-1.0574e1	-1.0555e1	-1.0439e1	-1.0639e1	-1.1277e1	-1.1576e1	-1.1551e1
-2.2411	-2.3426	-2.5222	-2.6589	-2.5952	-2.7573	-3.0264	-2.8184	-2.8634	-4.8037
-7.4196	-5.5105	-6.1002	-8.4757	-8.2318	-8.3171	-8.4006	-8.8536	-9.3111	-9.4444
-9.7984	-9.9775	-1.031e1	-1.0285e1	-1.0227e1	-1.0159e1	-1.0222e1	-1.0471e1	-1.0433e1	-1.0398e1
-2.2327	-2.2338	-2.2872	-2.3513	-2.1273	-2.1232	-2.3878	-2.9632	-3.5341	-5.6989
-8.4513	-8.3772	-6.8674	-6.8098	-8.4161	-8.4063	-8.4393	-8.4746	-9.1145	-9.4479
-9.7263	-9.5769	-9.6706	-9.6948	-1.0023e1	-9.9979	-9.9626	-9.9243	-1.0028e1	-1.0324e1
-2.0571	-1.9846	-1.8685	-1.6015	-1.4659	-1.6003	-1.9872	-2.3603	-4.4462	-6.0122
-7.9554	-7.7746	-7.5096	-7.2309	-7.4296	-8.1628	-8.1817	-8.1963	-9.0206	-9.2664
-9.4875	-9.6573	-9.7698	-9.8324	-9.4867	-9.4797	-9.4576	-9.8237	-9.8018	-9.7786
-1.9193	-1.7945	-1.52	-1.3552	-1.5183	-1.2971	-1.6695	-2.061	-4.979	-6.906
-7.6648	-7.6308	-7.6042	-7.4034	-7.3942	-7.4332	-8.1645	-8.1842	-8.198	-8.8395
-9.0301	-9.1897	-9.309	-9.6691	-9.7133	-9.735	-9.3435	-9.3315	-9.3135	-9.7104
-1.8324	-1.5658	-1.4735	-1.3743	-1.242	-1.336	-1.5856	-1.8873	-3.2908	-6.8929
-7.5523	-7.5515	-7.5131	-7.4052	-7.6794	-7.3963	-7.4172	-8.1728	-8.1892	-8.745
-8.902	-9.0399	-9.1519	-9.2354	-9.293	-9.3294	-9.3494	-9.6557	-9.2385	-9.227
-1.611	-1.5746	-1.4864	-1.4746	-1.4245	-1.4853	-1.6198	-1.8261	-5.2821	-6.2945
-7.4753	-7.47	-7.436	-7.3706	-7.2928	-8.0413	-7.3883	-7.4007	-7.4082	-8.683
-8.8145	-8.9335	-9.035	-9.1166	-9.1778	-9.2219	-9.2514	-9.2691	-9.2779	-9.2806
-1.599	-1.5842	-1.6399	-1.5831	-1.5666	-1.6123	-1.68	-2.659	-5.1427	-5.9981
-7.4154	-7.4071	-7.3807	-7.3368	-7.2836	-8.1323	-8.0617	-8.0698	-7.3866	-7.3913
-8.7538	-8.8569	-8.948	-9.0245	-9.0857	-9.1328	-9.1677	-9.1922	-9.2079	-9.2171
-1.6469	-1.6053	-1.7053	-1.6747	-1.6729	-1.7086	-2.4021	-2.7627	-5.0848	-5.7635
-6.2929	-7.3604	-7.3393	-7.3081	-7.2702	-7.6931	-8.068	-8.074	-8.0789	-7.3751
-8.7117	-8.8014	-8.8828	-8.9531	-9.012	-9.0598	-9.0974	-9.1257	-9.146	-9.1601
-1.6591	-1.7921	-1.7638	-1.7485	-1.753	-1.7817	-2.5586	-4.4989	-5.0706	-5.6073
-6.0525	-7.3243	-7.3077	-7.2842	-7.2561	-7.6963	-8.1602	-8.079	-8.0828	-8.0857
-7.3656	-8.7611	-8.8336	-8.8978	-8.9536	-9.0002	-9.0381	-9.0683	-9.0921	-9.1096
-1.6735	-1.8313	-1.8141	-1.807	-1.814	-2.3859	-2.682	-4.632	-5.0787	-5.5066
-5.8778	-6.4757	-7.2828	-7.2644	-7.2427	-7.2192	-8.1705	-8.1679	-8.0865	-8.0887
-8.0911	-8.7319	-8.7963	-8.8548	-8.9067	-8.9514	-8.9889	-9.0198	-9.045	-9.0645
-1.8828	-1.8665	-1.856	-1.8537	-2.3914	-2.4999	-2.777	-4.7418	-5.0972	-5.4424
-5.7522	-6.0107	-7.2622	-7.2479	-7.2305	-7.2119	-7.6915	-8.1759	-8.0901	-8.0919
-8.0936	-8.711	-8.7686	-8.8216	-8.8693	-8.9113	-8.9476	-8.9786	-9.0042	-9.0256
-1.9082	-1.8973	-1.8912	-1.8918	-2.4907	-2.5898	-2.8508	-4.8316	-5.1197	-5.4022
-5.6621	-5.8871	-7.2454	-7.2338	-7.2197	-7.2044	-7.6922	-8.1829	-8.1802	-8.095
-8.0963	-8.0973	-8.7473	-8.7954	-8.8392	-8.8785	-8.9132	-8.9434	-8.9694	-8.9912
-1.9313	-1.9239	-1.9208	-2.5042	-2.5714	-2.6612	-4.6803	-4.9061	-5.1434	-5.3779
-5.5974	-5.7928	-5.959	-7.2217	-7.21	-7.1976	-7.1845	-8.1886	-8.1856	-8.098
-8.0986	-8.0996	-8.7317	-8.7752	-8.8152	-8.8518	-8.885	-8.914	-8.9392	-8.961
-1.9519	-1.9474	-2.5272	-2.574	-2.6373	-2.718	-4.7786	-4.9682	-5.1667	-5.364
-5.551	-5.7211	-5.87	-7.2112	-7.2014	-7.1909	-7.1798	-7.688	-8.1905	-8.1881
-8.1012	-8.1019	-8.1026	-8.7592	-8.7961	-8.8301	-8.861	-8.8889	-8.9133	-8.935
-1.9704	-1.9676	-2.5866	-2.6326	-2.6912	-2.7634	-4.8597	-5.0208	-5.1889	-5.3568
-5.5175	-5.6665	-5.799	-6.2646	-7.1938	-7.1847	-7.1755	-7.6882	-8.1946	-8.1923
-8.1033	-8.1037	-8.1044	-8.747	-8.7805	-8.8122	-8.8412	-8.8675	-8.8911	-8.9121
-1.9866	-2.6033	-2.6375	-2.6813	-2.7357	-2.8003	-4.9271	-5.0659	-5.2098	-5.3539
-5.4933	-5.6239	-5.7427	-5.8476	-7.1869	-7.1791	-7.1713	-7.688	-8.1982	-8.196
-8.1938	-8.1054	-8.1058	-8.1063	-8.7683	-8.7977	-8.8248	-8.8495	-8.8721	-8.8927

11 1. (10G11.4) -1 Vcont Layer - 0

5.9522e-3	5.9513e-3	5.9503e-3	5.9491e-3	5.9481e-3	5.9472e-3	5.7972e-3	5.7664e-3	5.7338e-3	4.9925e-3
4.9454e-3	4.7157e-3	4.7236e-3	4.6091e-3	4.5736e-3	4.3412e-3	4.1758e-3	4.0735e-3	4.0275e-3	4.012e-3
4.01e-3	4.0131e-3	3.9935e-3	3.9125e-3	3.9155e-3	3.9179e-3	3.9198e-3	3.9213e-3	3.9226e-3	3.9237e-3
5.9527e-3	5.9517e-3	5.9503e-3	5.9489e-3	5.9475e-3	5.9465e-3	5.8266e-3	5.7934e-3	5.7349e-3	4.9946e-3
4.9352e-3	4.8981e-3	4.7531e-3	4.7951e-3	4.7397e-3	4.9062e-4	4.5886e-4	4.4527e-4	4.4167e-4	4.4174e-4
4.4281e-4	4.3374e-4	4.3433e-4	4.3479e-4	4.3514e-4	4.3541e-4	4.3562e-4	4.3579e-4	4.3593e-4	4.3604e-4
5.9538e-3	5.9525e-3	5.9506e-3	5.9489e-3	5.9469e-3	5.9455e-3	5.8618e-3	5.8286e-3	5.7563e-3	5.1661e-3
4.9186e-3	4.881e-3	4.7626e-3	4.8194e-3	4.8335e-3	4.8635e-4	4.4643e-4	4.352e-4	4.353e-4	4.3153e-4
4.3286e-4	4.3382e-4	4.3449e-4	4.3496e-4	4.3531e-4	4.3557e-4	4.3575e-4	4.3591e-4	4.3604e-4	4.3613e-4
6.0745e-3	5.9538e-3	5.9518e-3	5.9493e-3	5.9465e-3	5.9444e-3	5.915e-3	5.8699e-3	5.7845e-3	5.1399e-3
4.8902e-3	4.854e-3	4.7736e-3	4.7567e-3	4.5391e-3	4.1599e-3	4.3503e-4	4.272e-4	4.2905e-4	4.3159e-4
4.3324e-4	4.3422e-4	4.3484e-4	4.3526e-4	4.3556e-4	4.3576e-4	4.3593e-4	4.3606e-4	4.3683e-4	4.3707e-4
6.0843e-3	6.0791e-3	5.9541e-3	5.9506e-3	5.9465e-3	5.9434e-3	5.9316e-3	5.9208e-3	5.8134e-3	5.1015e-3
4.9018e-3	4.8209e-3	4.7763e-3	4.7369e-3	4.2297e-3	3.969e-3	4.3279e-4	4.2885e-4	4.3103e-4	4.3318e-4

4.3433e-4	4.3498e-4	4.3539e-4	4.3567e-4	4.3587e-4	4.3602e-4	4.3673e-4	4.3705e-4	4.373e-4	4.3749e-4
6.1662e-3	6.095e-3	6.0893e-3	6.0722e-3	5.9486e-3	5.9513e-3	5.9414e-3	5.9245e-3	5.8719e-3	5.0667e-3
4.827e-3	4.8008e-3	4.7888e-3	4.6533e-3	4.1384e-3	4.0292e-3	4.4642e-4	4.4327e-4	4.3695e-4	4.3601e-4
4.359e-4	4.3596e-4	4.3606e-4	4.3615e-4	4.3623e-4	4.3713e-4	4.3745e-4	4.3769e-4	4.3787e-4	4.38e-4
6.1766e-3	6.1706e-3	6.162e-3	6.1117e-3	6.0864e-3	5.9734e-3	5.9121e-3	5.8669e-3	5.4477e-3	4.9661e-3
4.8502e-3	4.8154e-3	4.7991e-3	4.6223e-3	4.0775e-3	4.0757e-3	4.0631e-3	4.4654e-4	4.4958e-4	4.5099e-4
4.3732e-4	4.3691e-4	4.3672e-4	4.3741e-4	4.3782e-4	4.3811e-4	4.3831e-4	4.3843e-4	4.3852e-4	4.3856e-4
6.2522e-3	6.1837e-3	6.1721e-3	6.1596e-3	6.145e-3	6.1039e-3	5.447e-3	5.385e-3	5.369e-3	5.2924e-3
4.9304e-3	4.9312e-3	4.9397e-3	4.5665e-3	4.0981e-3	4.1016e-3	4.1263e-3	4.5438e-4	4.527e-4	4.5248e-4
4.525e-4	4.5256e-4	4.5347e-4	4.4654e-4	4.4554e-4	4.4553e-4	4.4549e-4	4.4545e-4	4.454e-4	4.4536e-4
6.2688e-3	6.2501e-3	6.2152e-3	6.1596e-3	6.193e-3	6.037e-3	5.4385e-3	5.3645e-3	5.347e-3	5.3736e-3
5.4429e-3	5.2345e-3	5.194e-3	4.2921e-3	4.0736e-3	4.119e-3	4.2136e-3	4.608e-4	4.5566e-4	4.54e-4
4.5419e-4	4.5423e-4	4.5429e-4	4.5431e-4	4.543e-4	4.4775e-4	4.4755e-4	4.4637e-4	4.4617e-4	4.4601e-4
6.2961e-3	6.2927e-3	6.2909e-3	6.2561e-3	6.1851e-3	6.1532e-3	5.4187e-3	5.3674e-3	5.364e-3	5.399e-3
5.5467e-3	5.5977e-3	5.0613e-3	4.3897e-3	4.0572e-3	4.0348e-3	4.0672e-3	4.0852e-3	4.5279e-4	4.5583e-4
4.5548e-4	4.5534e-4	4.5518e-4	4.55e-4	4.5483e-4	4.5469e-4	4.5456e-4	4.5447e-4	4.4783e-4	4.476e-4
6.3279e-3	6.3408e-3	6.3717e-3	6.3943e-3	6.2973e-3	5.9308e-3	5.6404e-3	5.4656e-3	5.3925e-3	5.4796e-3
5.5559e-3	5.5755e-3	5.2141e-3	4.3507e-3	4.0468e-3	4.0201e-3	4.0143e-3	4.0724e-3	4.5475e-4	4.5605e-4
4.566e-4	4.5432e-4	4.5605e-4	4.5566e-4	4.5533e-4	4.5508e-4	4.5488e-4	4.5472e-4	4.546e-4	4.545e-4
6.5196e-3	6.5137e-3	6.5077e-3	6.5358e-3	6.4344e-3	5.8909e-3	5.7011e-3	5.5837e-3	5.5258e-3	5.7332e-3
5.5499e-3	5.4726e-3	5.0094e-3	4.4135e-3	4.113e-3	4.0263e-3	4.0625e-3	4.0024e-3	4.5482e-4	4.5699e-4
4.5751e-4	4.5715e-4	4.5666e-4	4.5388e-4	4.531e-4	4.5541e-4	4.5515e-4	4.5495e-4	4.5479e-4	4.5466e-4
6.6217e-3	6.5378e-3	6.554e-3	6.6162e-3	6.5493e-3	5.9465e-3	5.5666e-3	5.5413e-3	5.5465e-3	5.869e-3
5.6681e-3	5.2765e-3	4.7876e-3	4.6945e-3	4.2704e-3	4.1755e-3	4.0383e-3	4.0913e-3	4.0592e-3	4.5797e-4
4.5824e-4	4.5752e-4	4.5681e-4	4.563e-4	4.5595e-4	4.5475e-4	4.5232e-4	4.5194e-4	4.5494e-4	4.5479e-4
6.7604e-3	6.7892e-3	7.0933e-3	6.9527e-3	6.5663e-3	6.3949e-3	5.8118e-3	5.4639e-3	5.5076e-3	6.4258e-3
6.1216e-3	5.4037e-3	4.9935e-3	4.9752e-3	5.1576e-3	5.2982e-3	4.9619e-3	4.2313e-3	4.1573e-3	4.5951e-4
4.5665e-4	4.573e-4	4.567e-4	4.5621e-4	4.5587e-4	4.5561e-4	4.5542e-4	4.5422e-4	4.5174e-4	4.5148e-4
6.9111e-3	6.9047e-3	7.1525e-3	7.0313e-3	6.898e-3	6.3236e-3	5.8359e-3	5.6581e-3	6.622e-3	7.5675e-3
6.983e-3	6.3268e-3	5.3512e-3	5.5877e-3	5.7936e-3	5.6688e-3	5.6165e-3	5.1474e-3	4.6789e-3	4.9363e-4
4.8453e-4	4.8696e-4	4.6697e-4	4.5599e-4	4.5571e-4	4.5549e-4	4.5532e-4	4.5519e-4	4.5508e-4	4.5387e-4
6.7015e-3	6.5759e-3	6.3706e-3	5.9788e-3	6.0995e-3	6.0936e-3	6.6947e-3	7.0291e-3	7.2843e-3	7.3017e-3
6.8223e-3	6.7826e-3	5.6222e-3	5.6979e-3	5.9245e-3	5.8425e-3	5.7971e-3	5.3304e-3	5.0338e-3	4.7871e-3
5.0814e-4	5.0463e-4	5.0619e-4	5.0959e-4	5.1617e-4	5.1984e-4	5.2898e-4	4.7677e-4	4.5499e-4	4.5491e-4
6.2284e-3	6.1056e-3	5.8422e-3	5.4182e-3	5.6336e-3	6.2744e-3	6.8838e-3	7.2733e-3	7.2922e-3	6.6034e-3
6.2359e-3	7.408e-3	6.9744e-3	5.7657e-3	5.8691e-3	5.8318e-3	5.7962e-3	5.5291e-3	5.303e-3	5.005e-3
5.4101e-4	5.3355e-4	5.1937e-4	5.1956e-4	5.2094e-4	5.2274e-4	5.2805e-4	5.3633e-4	5.3823e-4	5.3994e-4
6.4131e-3	6.3183e-3	6.1294e-3	5.9031e-3	6.2054e-3	6.809e-3	7.4202e-3	7.2197e-3	7.017e-3	6.3402e-3
5.753e-3	5.7841e-3	6.5393e-3	6.5715e-3	5.79e-3	5.794e-3	5.7799e-3	5.765e-3	5.3996e-3	5.2399e-3
5.1135e-3	5.494e-4	5.4489e-4	5.4325e-4	5.2847e-4	5.2876e-4	5.2949e-4	5.3038e-4	5.3519e-4	5.4311e-4
6.5872e-3	6.6217e-3	6.7198e-3	7.0552e-3	7.3812e-3	7.3998e-3	7.5613e-3	7.4315e-3	6.7149e-3	6.2529e-3
5.9949e-3	6.1119e-3	6.2671e-3	6.3848e-3	6.2613e-3	5.9172e-3	5.9062e-3	5.8987e-3	5.4478e-3	5.3271e-3
5.2229e-3	5.7172e-4	5.6617e-4	5.6315e-4	5.5105e-4	5.5073e-4	5.5108e-4	5.3436e-4	5.3471e-4	5.3517e-4
6.7607e-3	6.8928e-3	7.2174e-3	7.5522e-3	7.4735e-3	7.7475e-3	7.6852e-3	7.539e-3	6.5504e-3	6.1404e-3
6.161e-3	6.2266e-3	6.2509e-3	6.3144e-3	6.2935e-3	6.2612e-3	5.9197e-3	5.9082e-3	5.9008e-3	5.5178e-3
5.4216e-3	5.3436e-3	5.8742e-4	5.7126e-4	5.6908e-4	5.6803e-4	5.5591e-4	5.5591e-4	5.562e-4	5.3796e-4
6.8823e-3	7.1533e-3	7.3293e-3	7.6108e-3	7.7969e-3	7.7154e-3	7.7227e-3	7.6041e-3	7.2409e-3	6.1686e-3
6.2215e-3	6.2428e-3	6.2677e-3	6.3088e-3	6.1323e-3	6.2852e-3	6.2678e-3	5.9169e-3	5.9074e-3	5.5676e-3
5.4865e-3	5.4172e-3	5.3623e-3	5.3221e-3	5.883e-4	5.8639e-4	5.8535e-4	5.7208e-4	5.5946e-4	5.5954e-4
7.0938e-3	7.1737e-3	7.3191e-3	7.5132e-3	7.5976e-3	7.5697e-3	7.7084e-3	7.6272e-3	6.5487e-3	6.4109e-3
6.2563e-3	6.2681e-3	6.2884e-3	6.3174e-3	6.3503e-3	5.9839e-3	6.2848e-3	6.2746e-3	6.2682e-3	5.6011e-3
5.5319e-3	5.4709e-3	5.42e-3	5.3798e-3	5.35e-3	5.9208e-4	5.9051e-4	5.8958e-4	5.8912e-4	5.8898e-4
7.1187e-3	7.1697e-3	7.3318e-3	7.4164e-3	7.4631e-3	7.4542e-3	7.6831e-3	7.4204e-3	6.5902e-3	6.3798e-3
6.2823e-3	6.2913e-3	6.3066e-3	6.3275e-3	6.3515e-3	5.9355e-3	5.9702e-3	5.9635e-3	6.2803e-3	6.2761e-3
5.564e-3	5.5103e-3	5.4639e-3	5.4254e-3	5.3951e-3	5.372e-3	5.95e-4	5.9369e-4	5.9284e-4	5.9235e-4
7.0832e-3	7.1466e-3	7.2888e-3	7.3424e-3	7.3721e-3	7.3713e-3	7.4946e-3	7.3903e-3	6.6066e-3	6.4364e-3
6.3146e-3	6.3098e-3	6.3219e-3	6.3374e-3	6.3551e-3	6.1105e-3	5.9673e-3	5.9621e-3	5.958e-3	6.2851e-3
5.5865e-3	5.5393e-3	5.4972e-3	5.4614e-3	5.4318e-3	5.408e-3	5.9883e-4	5.9729e-4	5.9619e-4	5.9542e-4
7.0723e-3	7.2071e-3	7.2514e-3	7.2872e-3	7.3082e-3	7.3108e-3	7.448e-3	6.7643e-3	6.6098e-3	6.4735e-3
6.3672e-3	6.3248e-3	6.3342e-3	6.3463e-3	6.3598e-3	6.1071e-3	5.9181e-3	5.9599e-3	5.9565e-3	5.9538e-3
6.289e-3	5.5605e-3	5.5227e-3	5.4896e-3	5.4612e-3	5.4377e-3	6.0209e-4	6.0043e-4	5.9913e-4	5.9816e-4
7.0573e-3	7.1882e-3	7.2202e-3	7.246e-3	7.262e-3	7.1091e-3	7.4117e-3	6.7261e-3	6.6061e-3	6.4966e-3
6.4058e-3	6.5256e-3	6.3444e-3	6.354e-3	6.3647e-3	6.376e-3	5.9127e-3	5.9125e-3	5.9549e-3	5.9527e-3
5.9506e-3	5.5761e-3	5.5422e-3	5.5118e-3	5.4852e-3	5.4624e-3	6.0484e-4	6.0311e-4	5.4154e-3	5.4057e-3
7.1442e-3	7.171e-3	7.1951e-3	7.2145e-3	7.0745e-3	7.0601e-3	7.3841e-3	6.6944e-3	6.5995e-3	6.5108e-3
6.4337e-3	6.3711e-3	6.353e-3	6.3606e-3	6.3693e-3	6.3784e-3	6.104e-3	5.9085e-3	5.9532e-3	5.9513e-3
5.9497e-3	5.5873e-3	5.5568e-3	5.5291e-3	5.5044e-3	5.4828e-3	5.4644e-3	5.4487e-3	5.4359e-3	5.4251e-3
7.1348e-3	7.1558e-3	7.1746e-3	7.1895e-3	7.0345e-3	7.0221e-3	7.3629e-3	6.6685e-3	6.592e-3	6.5191e-3
6.4537e-3	6.3982e-3	6.3603e-3	6.3664e-3	6.3736e-3	6.3812e-3	6.1027e-3	5.9048e-3	5.9052e-3	5.9498e-3
5.9485e-3	5.9473e-3	5.5681e-3	5.5428e-3	5.52e-3	5.4997e-3	5.4819e-3	5.4665e-3	5.4534e-3	5.4424e-3
7.1258e-3	7.1427e-3	7.1577e-3	7.0063e-3	7.0028e-3	6.9919e-3	6.7078e-3	6.6469e-3	6.5841e-3	6.5235e-3
6.4679e-3	6.4192e-3	6.3781e-3	6.3715e-3	6.3776e-3	6.3838e-3	6.3902e-3	5.9018e-3	5.9025e-3	5.9483e-3
5.9475e-3	5.9463e-3	5.5764e-3	5.5534e-3	5.5325e-3	5.5135e-3	5.4963e-3	5.4815e-3	5.4686e-3	5.4576e-3
7.1176e-3	7.1312e-3	6.9795e-3	6.981e-3	6.9771e-3	6.9677e-3	6.6798e-3	6.6289e-3	6.5765e-3	6.5253e-3
6.4778e-3	6.435e-3	6.3978e-3	6.376e-3	6.3812e-3	6.3865e-3	6.3921e-3	6.1019e-3	5.8999e-3	5.9005e-3
5.9462e-3	5.9453e-3	5.9445e-3	5.5619e-3	5.5424e-3	5.5247e-3	5.5087e-3	5.4944e-3	5.4819e-3	5.4708e-3
7.1099e-3	7.1212e-3	6.9599e-3	6.9599e-3	6.9561e-3	6.9481e-3	6.6565e-3	6.6135e-3	6.5693e-3	6.5257e-3
6.4846e-3	6.4469e-3	6.4137e-3	6.6011e-3	6.3844e-3	6.3891e-3	6.3937e-3	6.1012e-3	5.8977e-3	5.8983e-3
5.9451e-3	5.9445e-3	5.9437e-3	5.5683e-3	5.5506e-3	5.5341e-3	5.519e-3	5.5054e-3	5.4932e-3	5.4825e-3
7.1031e-3	6.941e-3	6.9431e-3	6.9425e-3	6.9386e-3	6.9319e-3	6.6372e-3	6.6003e-3	6.5625e-3	6.5252e-3
6.4894e-3	6.4562e-3	6.4261e-3	6.3997e-3	6.3874e-3	6.3914e-3	6.3953e-3	6.1007e-3	5.8958e-3	5.8964e-3
5.8971e-3	5.9437e-3	5.9431e-3	5.9425e-3	5.557e-3	5.5416e-3	5.5275e-3	5.5146e-3	5.503e-3	5.4924e-3
11	1. (10G11.4)			-1 Aquifer Top - 0					
6.3682	6.3533	6.3367	6.3198	6.3043	6.292	5.8819	5.8109	6.1065	4.2468
4.2537	4.3739	4.6999	5.269	5.3845	5.3393	5.3244	5.3234	5.2912	5.2209
5.1335	5.0482	4.945	4.4084	4.3401	4.285	4.2404	4.2041	4.1742	4.1494
6.3769	6.3593	6.3386	6.3166	6.296	6.28	5.9493	5.8732	5.7372	4.1597
4.1185	4.2821	4.737	5.2633	5.5155	5.4146	5.4173	5.4623	5.4164	5.2963
5.1631	4.6158	4.4902	4.3943	4.3212	4.2647	4.2204	4.185	4.1565	4.133
6.391	6.3709	6.3451	6.3157	6.2874	6.2658	6.0283	5.9533	5.7875	4.2059
3.8915	4.0013	4.5327	5.3386	5.5806	5.4188	5.5504	5.7033	5.5912	5.0768
4.7974	4.5964	4.4565	4.3577	4.2861	4.2326	4.1916	4.1595	4.1338	4.1129
6.697	6.392	6.3609	6.3211	6.2803	6.2495	6.1343	6.0467	5.8528	4.1254
3.5933	3.5627	3.7185	4.652	5.2721	5.2417	5.6784	6.0096	5.5943	5.0607
4.7184	4.5121	4.3819	4.2948	4.2335	4.1886	4.1545	4.1279	4.0619	4.0303
6.729	6.7128	6.3958	6.343	6.281	6.2338	6.1781	6.1496	5.9188	4.0062
3.3554	3.1784	3.2046	3.5073	4.1625	4.372	4.8483	5.6199	5.1791	4.7334
4.4916	4.3531	4.2662	4.2076	4.1657	4.1345	4.0717	4.0316	4.0003	3.9756
7.0664	6.7641	6.7467	6.6916	6.312	6.2231	6.2046	6.1595	6.0363	3.8963
3.0948	3.0108	3.0418	3.0131	2.846	3.0681	3.035	3.2053	3.9819	4.1469
4.1622	4.1457	4.1246	4.105	4.0881	4.015	3.9787	3.9511	3.9302	3.9145
7.1037	7.0735	7.0324	6.8201	6.7331	6.2633	6.1264	6.0041	4.721	3.5494
3.1724	3.0241	2.9958	3.0187	2.636	2.7442	2.573	2.7935	2.6712	2.613
3.8597	3.9433	3.9824	3.9469	3.915	3.8905	3.8731	3.8611	3.8532	3.8481
7.8863	7.1228	7.0662	7.0082	6.9115	6.7739	4.7084	4.4851	4.4391	4.2443
3.4352	3.0562	3.0595	3.0286	2.7455	2.5006	2.2467	2.3988	2.5087	2.5345
2.5417	2.5441	2.4918	2.9069	3.6223	3.6272	3.6335	3.6404	3.6475	3.6543
8.0264	7.7919	7.4606	7.0795	6.9502	6.5161	4.6112	4.3747	4.3665	4.2904
4.063	3.1704	3.1551	3.9333	3.9501	3.3238	1.734	2.0726	2.3604	2.4574
2.4464	2.4432	2.4397	2.4395	2.4417	2.8243	2.8435	3.5345	3.5585	3.5789

8.2791	8.1084	7.9006	7.6108	7.0913	7.0317	4.6414	4.423	4.3332	4.2102
3.6301	3.4429	3.6581	4.2046	4.5048	4.3959	3.6406	3.1757	3.1298	2.3511
2.3637	2.3698	2.3803	2.3932	2.4058	2.417	2.4265	2.4345	2.8231	2.8415
8.642	8.5689	8.3408	8.1517	8.4604	7.5366	5.7346	5.0254	4.5892	3.8564
3.4507	3.3597	3.8376	4.644	4.7055	4.5883	4.4087	3.717	3.2769	2.9226
2.7478	2.3685	2.3188	2.3472	2.3711	2.3902	2.4053	2.4173	2.4271	2.435
9.6664	9.6988	9.8179	1.0698e1	1.0678e1	7.223	6.0321	5.7676	5.4473	3.8831
3.5523	3.4461	4.5016	5.4665	5.36	4.9643	4.5877	4.3301	3.0882	2.5368
2.3955	2.5198	2.6802	2.3986	2.4381	2.3672	2.3869	2.4023	2.4146	2.4245
9.4114	9.8688	1.0264e1	1.1719e1	1.2457e1	7.1571	5.9622	5.6037	4.7003	3.8135
3.7967	4.3619	5.5806	5.8412	6.1019	5.486	5.1908	4.1884	3.2195	2.2414
2.1735	2.3862	2.6032	2.7655	2.8818	2.7689	2.4867	2.5063	2.4042	2.4155
8.9107	8.8631	7.5609	7.1524	8.0656	5.0123	5.4305	4.9592	4.3782	3.5205
3.5173	3.4031	4.3522	4.6461	4.6755	4.1925	3.6861	3.7584	3.2597	2.5221
2.3832	2.437	2.621	2.7711	2.8835	2.9672	3.0308	2.8559	2.5228	2.5355
7.2679	7.2098	6.3015	6.5091	6.6297	6.2256	5.1909	4.7261	3.3753	2.8051
2.9662	2.2351	2.0776	1.8757	1.9935	2.6074	2.757	2.7863	2.6223	2.4483
2.3796	2.4045	2.7748	2.8218	2.9131	2.9859	3.0434	3.0893	3.1266	2.9148
7.3418	7.3431	7.3442	7.2957	7.1302	6.5799	5.3184	5.2211	4.5971	3.8192
2.6568	2.4203	1.892	1.9344	2.0735	2.0219	1.9961	2.6409	2.626	2.557
2.5081	2.5037	2.5287	2.5645	2.4164	2.4401	2.0175	2.7662	3.1388	3.1667
7.4335	7.5265	7.7919	8.4625	8.1009	6.8463	5.7271	5.4664	5.3998	4.3216
2.2434	2.6236	2.5396	1.9753	2.0351	2.0154	1.9954	2.0447	2.0518	2.5952
2.577	2.5711	2.5811	2.6011	2.6251	2.6494	2.4573	2.0121	2.0065	2.0017
7.1632	7.3031	7.5437	7.8564	7.5832	6.7265	5.7329	5.383	5.0532	3.8051
2.0228	2.0406	2.3472	2.3597	1.991	1.9937	1.9861	1.9778	2.0451	2.0517
2.0577	2.6097	2.6168	2.6297	2.6463	2.6643	2.6822	2.6992	2.4819	2.0036
7.0906	7.1153	7.0987	6.9393	6.6977	6.5428	5.982	5.748	4.5275	3.6245
2.0961	2.0845	2.1052	2.2067	2.1942	2.0206	2.0208	2.019	2.0402	2.0451
2.0498	2.0534	2.0557	2.0566	2.6633	2.6773	2.6918	2.7059	2.7194	2.732
6.9936	6.9476	6.8289	6.6236	6.5445	6.4805	6.1712	5.9318	4.2201	2.9073
2.1157	2.0466	2.0356	2.1395	2.1804	2.1908	2.0147	2.0147	2.0137	2.081
2.0842	2.0868	2.0887	2.0511	2.0517	2.0517	2.7004	2.7124	2.7241	2.7352
6.923	6.8579	6.748	6.5431	6.4864	6.474	6.2171	6.037	5.0311	2.8755
2.133	2.1007	2.1008	2.1461	2.1468	2.191	2.1966	2.0112	2.0111	2.0778
2.0808	2.0834	2.0853	2.0868	2.0877	2.0883	2.0886	2.0477	2.7288	2.7387
6.8834	6.8251	6.7465	6.5457	6.5066	6.475	6.1973	6.0743	3.9194	3.1048
2.1562	2.1433	2.1463	2.1678	2.196	2.0286	2.1996	2.2028	2.2051	2.0752
2.0782	2.0806	2.0826	2.0841	2.0853	2.0861	2.0866	2.0869	2.087	2.0871
6.8656	6.8202	6.5787	6.5418	6.5074	6.4713	6.1629	5.4615	4.0008	3.447
2.1762	2.1708	2.174	2.1863	2.2035	2.0198	2.0313	2.0346	2.208	2.2098
2.0761	2.0785	2.0804	2.082	2.0832	2.0841	2.0848	2.0853	2.0856	2.0857
6.8602	6.8263	6.5618	6.532	6.5008	6.4659	5.638	5.3909	4.036	3.5984
3.2496	2.1895	2.1923	2.2002	2.2115	2.1681	2.0299	2.0328	2.0349	2.2123
2.0746	2.0768	2.0787	2.0802	2.0815	2.0825	2.0832	2.0838	2.0842	2.0845
6.8611	6.5688	6.546	6.5204	6.4921	6.4605	5.5318	4.4092	4.0458	3.701
3.4113	2.2029	2.2053	2.2108	2.2187	2.1705	2.0216	2.0316	2.0335	2.0351
2.2158	2.0755	2.0773	2.0788	2.08	2.0811	2.0819	2.0825	2.083	2.0834
6.8648	6.5515	6.5316	6.509	6.4837	6.0902	5.4481	4.3267	4.0427	3.7686
3.5289	2.7583	2.215	2.2191	2.2248	2.2315	2.0207	2.0236	2.0325	2.034
2.0352	2.0745	2.0762	2.0776	2.0788	2.0799	2.0807	2.0814	2.082	2.0824
6.5516	6.5365	6.5188	6.4986	6.1262	6.0351	5.3834	4.2594	4.0334	3.8126
3.6137	3.4473	2.2226	2.2257	2.2301	2.2352	2.1803	2.0226	2.0318	2.0332
2.0343	2.0738	2.0753	2.0767	2.0779	2.0789	2.0797	2.0804	2.081	2.0815
6.5373	6.5235	6.5075	6.4895	6.0753	5.9913	5.3332	4.2045	4.0214	3.841
3.6748	3.5308	2.2286	2.2311	2.2345	2.2385	2.1817	2.022	2.0239	2.0326
2.0336	2.0345	2.0747	2.0759	2.077	2.078	2.0789	2.0796	2.0802	2.0807
6.5249	6.5123	6.4978	6.0963	6.0334	5.957	4.3028	4.1594	4.0086	3.8591
3.719	3.5943	3.4886	2.2356	2.2383	2.2415	2.2451	2.0215	2.0232	2.0321
2.033	2.0339	2.0742	2.0753	2.0764	2.0773	2.0782	2.0789	2.0795	2.08
6.5141	6.5025	6.1063	6.0577	5.9992	5.9301	4.2423	4.1219	3.9959	3.8704
3.7512	3.6429	3.5485	2.2394	2.2416	2.2442	2.2471	2.1872	2.0228	2.0242
2.0326	2.0334	2.0341	2.0749	2.0759	2.0768	2.0775	2.0782	2.0788	2.0794
6.5048	6.4941	6.0713	6.0253	5.9713	5.9091	4.1928	4.0904	3.9837	3.8771
3.7748	3.6803	3.5962	2.8638	2.2444	2.2466	2.2491	2.1882	2.0224	2.0237
2.0323	2.033	2.0337	2.0745	2.0754	2.0763	2.077	2.0777	2.0783	2.0788
6.4966	6.0781	6.0413	5.9983	5.9487	5.8925	4.1517	4.0637	3.9723	3.8807
3.7922	3.7093	3.6342	3.568	2.2469	2.2488	2.2509	2.1891	2.0222	2.0233
2.0244	2.0327	2.0333	2.0338	2.0751	2.0759	2.0766	2.0773	2.0778	2.0783

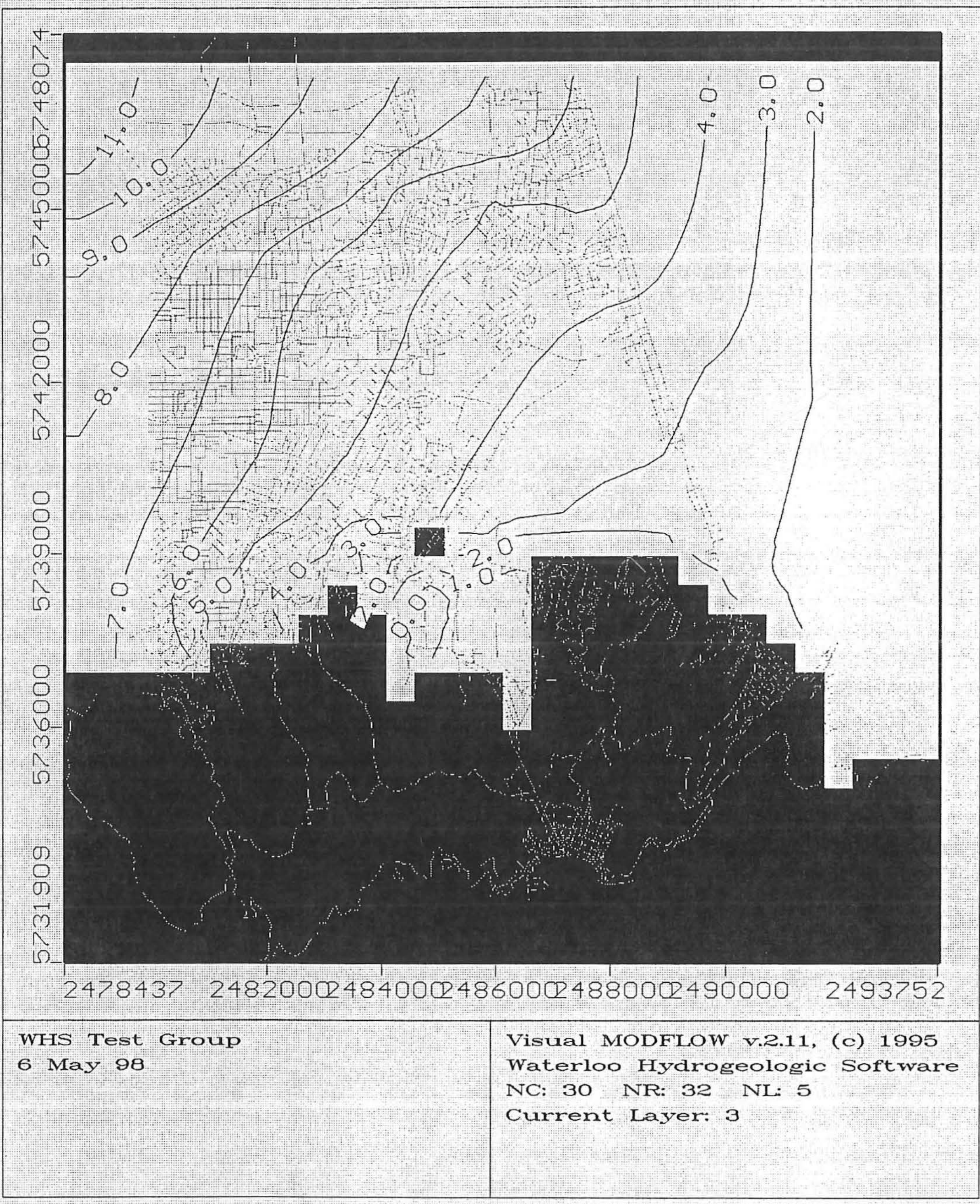
11 1. (10G11.4) -1 Conductivity Layer - 1

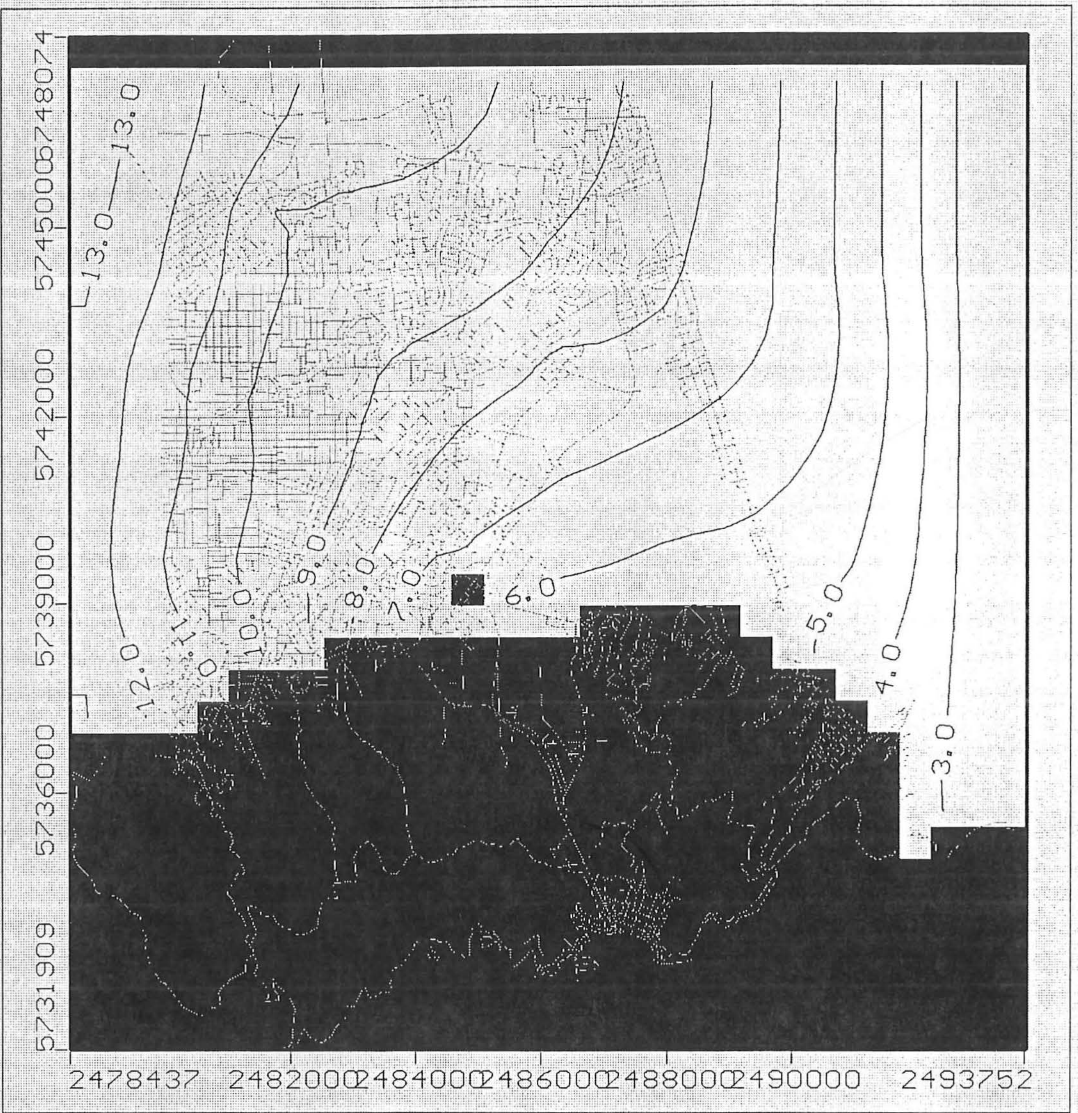
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3	8.64e-3	8.64e-3
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3	8.64e-3	8.64e-3
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3	8.64e-3	8.64e-3
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3	8.64e-3
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3	8.64e-3
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3	8.64e-3
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3	8.64e-3
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	8.64e-3
8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3	8.64e-3
7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2	7.776e-2

-6.5234e1	-6.5274e1	-6.5309e1	-6.5337e1	-6.536e1	-6.5378e1	-6.5393e1	-6.5404e1	-6.5414e1	-6.5422e1
-5.1373e1	-5.1437e1	-5.1512e1	-5.1591e1	-5.1666e1	-5.1723e1	-5.2588e1	-5.2764e1	-5.308e1	-5.731e1
-5.8108e1	-5.8653e1	-6.1857e1	-6.2305e1	-6.2909e1	-6.4803e1	-6.5111e1	-6.507e1	-6.5091e1	-6.515e1
-6.5214e1	-6.5269e1	-6.5311e1	-6.5343e1	-6.5367e1	-6.5386e1	-6.54e1	-6.5411e1	-6.542e1	-6.5428e1
-5.1322e1	-5.1395e1	-5.1488e1	-5.1595e1	-5.1697e1	-5.1775e1	-5.2405e1	-5.2579e1	-5.2963e1	-5.7436e1
-5.851e1	-5.9136e1	-6.1563e1	-6.2075e1	-6.2867e1	-6.4803e1	-6.5022e1	-6.4944e1	-6.5001e1	-6.5113e1
-6.5209e1	-6.5277e1	-6.5324e1	-6.5357e1	-6.538e1	-6.5397e1	-6.541e1	-6.542e1	-6.5428e1	-6.5435e1
-4.9761e1	-5.1318e1	-5.1431e1	-5.1575e1	-5.1723e1	-5.1834e1	-5.2182e1	-5.2362e1	-5.2812e1	-5.7652e1
-5.9072e1	-5.9725e1	-6.1272e1	-6.1731e1	-6.3344e1	-6.4808e1	-6.4955e1	-6.4784e1	-6.4936e1	-6.5122e1
-6.5239e1	-6.5308e1	-6.5351e1	-6.5379e1	-6.5398e1	-6.5412e1	-6.5423e1	-6.5431e1	-6.5438e1	-6.5443e1
-4.9605e1	-4.9685e1	-5.1305e1	-5.1496e1	-5.172e1	-5.1891e1	-5.2066e1	-5.2142e1	-5.2659e1	-5.7972e1
-5.9718e1	-6.0307e1	-6.0915e1	-6.1388e1	-6.4786e1	-6.4812e1	-6.5191e1	-6.4935e1	-6.5089e1	-6.5241e1
-6.5321e1	-6.5365e1	-6.5391e1	-6.5409e1	-6.5422e1	-6.5431e1	-6.5438e1	-6.5444e1	-6.5448e1	-6.5452e1
-4.8511e1	-4.9435e1	-4.9521e1	-4.9789e1	-5.1608e1	-5.19e1	-5.1996e1	-5.2115e1	-5.2179e1	-5.8267e1
-6.035e1	-6.0647e1	-6.0766e1	-6.1337e1	-6.4198e1	-6.503e1	-6.5289e1	-6.5596e1	-6.5534e1	-6.5453e1
-6.5437e1	-6.5437e1	-6.544e1	-6.5444e1	-6.5448e1	-6.5452e1	-6.5454e1	-6.5457e1	-6.5459e1	-6.5461e1
-4.834e1	-4.8404e1	-4.8502e1	-4.9165e1	-4.9583e1	-5.1688e1	-5.2203e1	-5.2526e1	-5.4095e1	-5.8793e1
-6.0086e1	-6.0595e1	-6.0805e1	-6.1479e1	-6.5222e1	-6.4951e1	-6.5217e1	-6.5687e1	-6.5597e1	-6.5577e1
-6.554e1	-6.5505e1	-6.5488e1	-6.573e1	-6.5729e1	-6.5729e1	-6.573e1	-6.5731e1	-6.5733e1	-6.5735e1
-4.8151e1	-4.8197e1	-4.8303e1	-4.8414e1	-4.8705e1	-4.9368e1	-5.4141e1	-5.4861e1	-5.5031e1	-5.6337e1
-5.9189e1	-6.0617e1	-6.0608e1	-6.1739e1	-6.5083e1	-6.536e1	-6.5768e1	-6.571e1	-6.5649e1	-6.5618e1
-6.5598e1	-6.5583e1	-6.5435e1	-6.5789e1	-6.5775e1	-6.5766e1	-6.576e1	-6.5756e1	-6.5754e1	-6.5752e1
-4.8158e1	-4.8062e1	-4.7856e1	-4.8313e1	-4.8405e1	-4.9686e1	-5.3818e1	-5.5314e1	-5.5325e1	-5.6088e1
-5.7674e1	-6.0606e1	-6.0566e1	-6.3789e1	-6.428e1	-6.4897e1	-6.6627e1	-6.6144e1	-6.5783e1	-6.5675e1
-6.5629e1	-6.5604e1	-6.5588e1	-6.5576e1	-6.5568e1	-6.58e1	-6.5788e1	-6.578e1	-6.5774e1	-6.577e1
-4.8073e1	-4.7762e1	-4.7371e1	-4.7372e1	-4.7905e1	-4.7687e1	-5.3065e1	-5.4689e1	-5.5438e1	-5.6765e1
-5.9015e1	-6.0477e1	-6.1482e1	-6.2799e1	-6.3932e1	-6.4025e1	-6.4824e1	-6.5284e1	-6.5321e1	-6.5705e1
-6.5651e1	-6.5619e1	-6.5599e1	-6.5586e1	-6.5575e1	-6.5568e1	-6.5562e1	-6.5414e1	-6.5793e1	-6.5786e1
-4.8127e1	-4.7626e1	-4.6478e1	-4.5691e1	-4.679e1	-4.8657e1	-5.1606e1	-5.4723e1	-5.491e1	-5.7685e1
-5.9411e1	-6.0492e1	-6.0041e1	-6.2686e1	-6.3563e1	-6.3855e1	-6.4248e1	-6.4695e1	-6.4945e1	-6.505e1
-6.5091e1	-6.5556e1	-6.5607e1	-6.5592e1	-6.5581e1	-6.5573e1	-6.5566e1	-6.5561e1	-6.5556e1	-6.5553e1
-4.8515e1	-4.8254e1	-4.763e1	-4.8081e1	-4.9275e1	-4.7465e1	-5.0884e1	-5.2971e1	-5.3897e1	-5.7633e1
-5.8797e1	-5.8848e1	-5.8359e1	-5.8961e1	-6.2018e1	-6.3323e1	-6.344e1	-6.3512e1	-6.4739e1	-6.4881e1
-6.4961e1	-6.5006e1	-6.5022e1	-6.5505e1	-6.5514e1	-6.5576e1	-6.5569e1	-6.5563e1	-6.5559e1	-6.5555e1
-4.9288e1	-4.9239e1	-4.9785e1	-5.1269e1	-5.234e1	-5.0557e1	-5.5277e1	-5.3895e1	-5.6101e1	-5.656e1
-5.7966e1	-5.7376e1	-5.4999e1	-5.4693e1	-5.8878e1	-6.0909e1	-6.1405e1	-6.3026e1	-6.3116e1	-6.3137e1
-6.4871e1	-6.4929e1	-6.4967e1	-6.4982e1	-6.4999e1	-6.5011e1	-6.549e1	-6.5286e1	-6.5283e1	-6.5557e1
-4.9556e1	-4.9863e1	-5.045e1	-5.1093e1	-4.9313e1	-5.1416e1	-5.2839e1	-5.5218e1	-5.6563e1	-5.6967e1
-5.7084e1	-5.6016e1	-5.512e1	-5.5226e1	-5.5807e1	-5.6082e1	-6.1035e1	-6.1336e1	-6.1479e1	-6.154e1
-6.2693e1	-6.2764e1	-6.2806e1	-6.2829e1	-6.4959e1	-6.4976e1	-6.4988e1	-6.4996e1	-6.5477e1	-6.5481e1
-4.9555e1	-4.9725e1	-4.9965e1	-5.0094e1	-5.0479e1	-5.1883e1	-5.3686e1	-5.5059e1	-5.5943e1	-5.7835e1
-5.4737e1	-5.2923e1	-5.5554e1	-5.5943e1	-5.6561e1	-5.6522e1	-5.6398e1	-5.7777e1	-6.08e1	-6.1044e1
-6.119e1	-6.1279e1	-6.1335e1	-6.2585e1	-6.2636e1	-6.267e1	-6.2693e1	-6.4972e1	-6.498e1	-6.4987e1
-4.9388e1	-4.932e1	-4.9091e1	-4.9125e1	-4.9677e1	-5.0501e1	-5.1562e1	-5.219e1	-5.2737e1	-5.3375e1
-5.1207e1	-4.9841e1	-5.4053e1	-5.6265e1	-5.7203e1	-5.6559e1	-5.6566e1	-5.6413e1	-5.6317e1	-5.7821e1
-6.0855e1	-6.1012e1	-6.1119e1	-6.1193e1	-6.1245e1	-6.1946e1	-6.1997e1	-6.2583e1	-6.2609e1	-6.2628e1
-4.9198e1	-4.895e1	-4.86e1	-4.7632e1	-4.8101e1	-4.9269e1	-5.0748e1	-5.0748e1	-5.0726e1	-5.0874e1
-4.9335e1	-4.7986e1	-4.9752e1	-5.5853e1	-5.6706e1	-5.6377e1	-5.6072e1	-5.5865e1	-5.5721e1	-5.6285e1
-5.776e1	-5.7851e1	-6.093e1	-6.1033e1	-6.1109e1	-6.1166e1	-6.121e1	-6.1906e1	-6.1949e1	-6.1982e1
-4.9089e1	-4.9219e1	-4.8645e1	-4.8126e1	-4.8268e1	-4.9228e1	-5.0541e1	-5.1038e1	-5.0635e1	-4.9547e1
-4.9104e1	-4.9196e1	-4.9013e1	-5.2095e1	-5.5789e1	-5.5923e1	-5.5672e1	-5.5544e1	-5.5433e1	-5.5344e1
-5.5272e1	-5.5214e1	-5.7812e1	-5.7871e1	-5.7917e1	-6.1061e1	-6.1117e1	-6.1161e1	-6.1844e1	-6.1888e1
-4.9617e1	-4.9336e1	-4.9025e1	-4.8542e1	-4.88e1	-4.9967e1	-5.0291e1	-5.0698e1	-4.9652e1	-4.9205e1
-4.8804e1	-4.8546e1	-4.8391e1	-4.9824e1	-5.1989e1	-5.4861e1	-5.5101e1	-5.5166e1	-5.5169e1	-5.5149e1
-5.5123e1	-5.5096e1	-5.5071e1	-5.5047e1	-5.7843e1	-5.7885e1	-5.7918e1	-6.1088e1	-6.113e1	-6.1165e1
-4.9695e1	-4.952e1	-4.8899e1	-4.8934e1	-4.9128e1	-5.0131e1	-5.0236e1	-4.9585e1	-4.9341e1	-4.899e1
-4.8535e1	-4.8163e1	-4.8173e1	-4.922e1	-5.1363e1	-5.1882e1	-5.4541e1	-5.4777e1	-5.4889e1	-5.4941e1
-5.4963e1	-5.497e1	-5.4968e1	-5.4963e1	-5.4955e1	-5.4946e1	-5.4937e1	-5.7895e1	-5.792e1	-6.1111e1
-4.9795e1	-4.9475e1	-4.9111e1	-4.9171e1	-4.9313e1	-4.9174e1	-4.9333e1	-4.9392e1	-4.9151e1	-4.9205e1
-4.8519e1	-4.8279e1	-4.8769e1	-4.9313e1	-5.101e1	-5.1779e1	-5.2282e1	-5.4447e1	-5.4635e1	-5.4743e1
-5.4807e1	-5.4844e1	-5.4866e1	-5.4877e1	-5.4883e1	-5.4885e1	-5.4884e1	-5.4882e1	-5.4879e1	-5.4876e1
-4.9652e1	-4.9241e1	-4.9258e1	-4.9318e1	-4.9177e1	-4.9166e1	-4.9251e1	-4.9271e1	-4.9389e1	-4.9186e1
-4.8579e1	-4.844e1	-4.9241e1	-4.9553e1	-4.9986e1	-5.1562e1	-5.1994e1	-5.2295e1	-5.3425e1	-5.4573e1
-5.4666e1	-5.4727e1	-5.4768e1	-5.4795e1	-5.4813e1	-5.4825e1	-5.4832e1	-5.4837e1	-5.4839e1	-5.484e1
-4.9729e1	-4.9335e1	-4.9361e1	-4.9413e1	-4.9083e1	-4.9151e1	-4.9196e1	-4.9198e1	-4.9352e1	-4.9206e1
-4.8636e1	-4.8543e1	-4.9549e1	-4.9756e1	-5.0042e1	-5.1497e1	-5.1842e1	-5.211e1	-5.2306e1	-5.3407e1
-5.4548e1	-5.4625e1	-5.4679e1	-5.4718e1	-5.4747e1	-5.4767e1	-5.4781e1	-5.4792e1	-5.4799e1	-5.4804e1
-4.9792e1	-4.9406e1	-4.9433e1	-4.9049e1	-4.9095e1	-4.9136e1	-4.916e1	-4.9155e1	-4.9341e1	-4.9234e1
-4.8679e1	-4.8612e1	-4.9759e1	-4.9911e1	-5.0112e1	-5.1502e1	-5.177e1	-5.1997e1	-5.2177e1	-5.2314e1
-5.3401e1	-5.4539e1	-5.4603e1	-5.465e1	-5.4686e1	-5.4713e1	-5.4734e1	-5.4749e1	-5.4761e1	-5.477e1
-4.9446e1	-4.9461e1	-4.8952e1	-4.9069e1	-4.9099e1	-4.9124e1	-4.9137e1	-4.913e1	-4.9341e1	-4.9262e1
-4.8712e1	-4.866e1	-4.9911e1	-5.0028e1	-5.0178e1	-5.1534e1	-5.1744e1	-5.1932e1	-5.2091e1	-5.2219e1
-5.2319e1	-5.3401e1	-5.4539e1	-5.4591e1	-5.4633e1	-5.4665e1	-5.469e1	-5.471e1	-5.4725e1	-5.4738e1
-4.9488e1	-4.8951e1	-4.9059e1	-4.908e1	-4.91e1	-4.9116e1	-4.9122e1	-4.9116e1	-4.9347e1	-4.9287e1
-4.8737e1	-4.8696e1	-5.0026e1	-5.012e1	-5.0236e1	-5.0365e1	-5.1743e1	-5.1898e1	-5.2035e1	-5.2151e1
-5.2246e1	-5.2323e1	-5.3403e1	-5.4542e1	-5.4586e1	-5.4622e1	-5.465e1	-5.4673e1	-5.4692e1	-5.4707e1
-4.8953e1	-4.8964e1	-4.9072e1	-4.9087e1	-4.9101e1	-4.911e1	-4.9113e1	-4.9108e1	-4.9355e1	-4.9308e1
-4.8756e1	-4.8722e1	-5.0116e1	-5.0193e1	-5.0286e1	-5.0389e1	-5.1754e1	-5.1883e1	-5.2e1	-5.2103e1
-5.2191e1	-5.2265e1	-5.2325e1	-5.3407e1	-5.4547e1	-5.4585e1	-5.4616e1	-5.4641e1	-5.4662e1	-5.4679e1
-4.8965e1	-4.9069e1	-4.908e1	-4.9091e1	-4.91e1	-4.9107e1	-4.9108e1	-4.9104e1	-4.9364e1	-4.9326e1
-4.8771e1	-4.8743e1	-5.0188e1	-5.0253e1	-5.0329e1	-5.0413e1	-5.1771e1	-5.1879e1	-5.1979e1	-5.2071e1
-5.2151e1	-5.222e1	-5.2278e1	-5.2327e1	-5.341e1	-5.4553e1	-5.4585e1	-5.4612e1	-5.4635e1	-5.4654e1
-4.8973e1	-4.9078e1	-4.9086e1	-4.9094e1	-4.9101e1	-4.9105e1	-4.9105e1	-4.9102e1	-4.9372e1	-4.9341e1
-4.8783e1	-4.876e1	-4.8739e1	-5.0302e1	-5.0366e1	-5.0436e1	-5.051e1	-5.1882e1	-5.1969e1	-5.2049e1
-5.2121e1	-5.2185e1	-5.224e1	-5.2288e1	-5.2328e1	-5.3413e1	-5.4559e1	-5.4587e1	-5.4611e1	-5.4631e1
-4.9078e1	-4.9084e1	-4.9091e1	-4.9097e1	-4.9101e1	-4.9104e1	-4.9104e1	-4.9102e1	-4.938e1	-4.9354e1
-4.8793e1	-4.8773e1	-4.8755e1	-5.0344e1	-5.0399e1	-5.0458e1	-5.052e1	-5.189e1	-5.1965e1	-5.2035e1
-5.21e1	-5.2159e1	-5.221e1	-5.2256e1	-5.2295e1	-5.2328e1	-5.3416e1	-5.4565e1	-5.4589e1	-5.461e1
-4.9085e1	-4.9089e1	-4.9094e1	-4.9099e1	-4.9102e1	-4.9104e1	-4.9104e1	-4.9102e1	-4.9387e1	-4.9365e1
-4.8802e1	-4.8784e1	-4.8768e1	-5.038e1	-5.0427e1	-5.0478e1	-5.0531e1	-5.19e1	-5.1965e1	-5.2027e1
-5.2085e1	-5.2139e1	-5.2187e1	-5.223e1	-5.2267e1	-5.23e1	-5.2329e1	-5.3419e1	-5.4571e1	-5.4592e1
-4.909e1	-4.9094e1	-4.9097e1	-4.9101e1	-4.9103e1	-4.9105e1	-4.9105e1	-4.9103e1	-4.9393e1	-4.9375e1
-4.8809e1	-4.8793e1	-4.8779e1	-5.0411e1	-5.0452e1	-5.0496e1	-5.0542e1	-5.0589e1	-5.1969e1	-5.2024e1
-5.2076e1	-5.2124e1	-5.2168e1	-5.2209e1	-5.2245e1	-5.2276e1	-5.2304e1	-5.2329e1	-5.3422e1	-5.4577e1

Appendix F.4 Management scenarios.

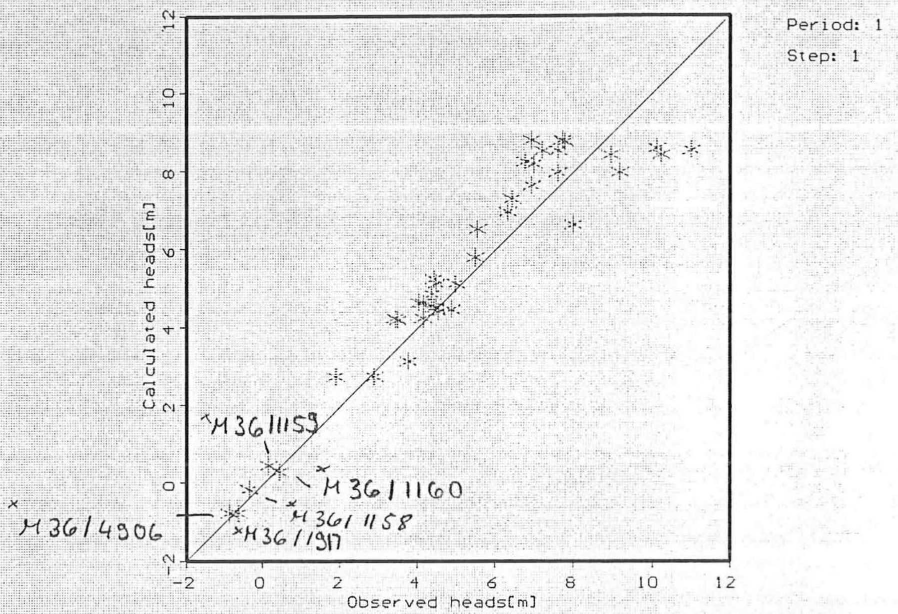
Output for calibrated steady-state model.





WHS Test Group
6 May 98

Visual MODFLOW v.2.11, (c) 1995
Waterloo Hydrogeologic Software
NC: 30 NR: 32 NL: 5
Current Layer: 5

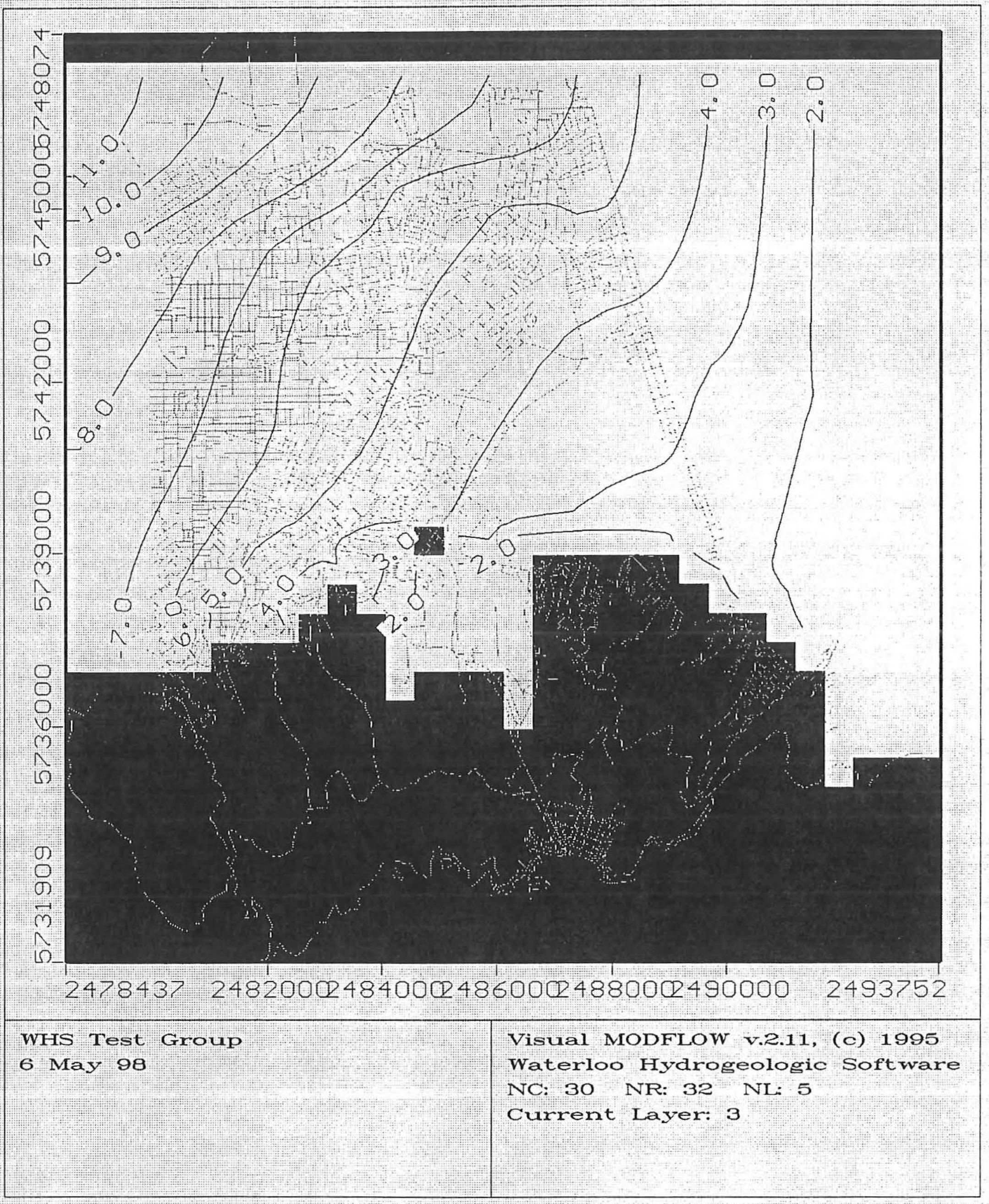


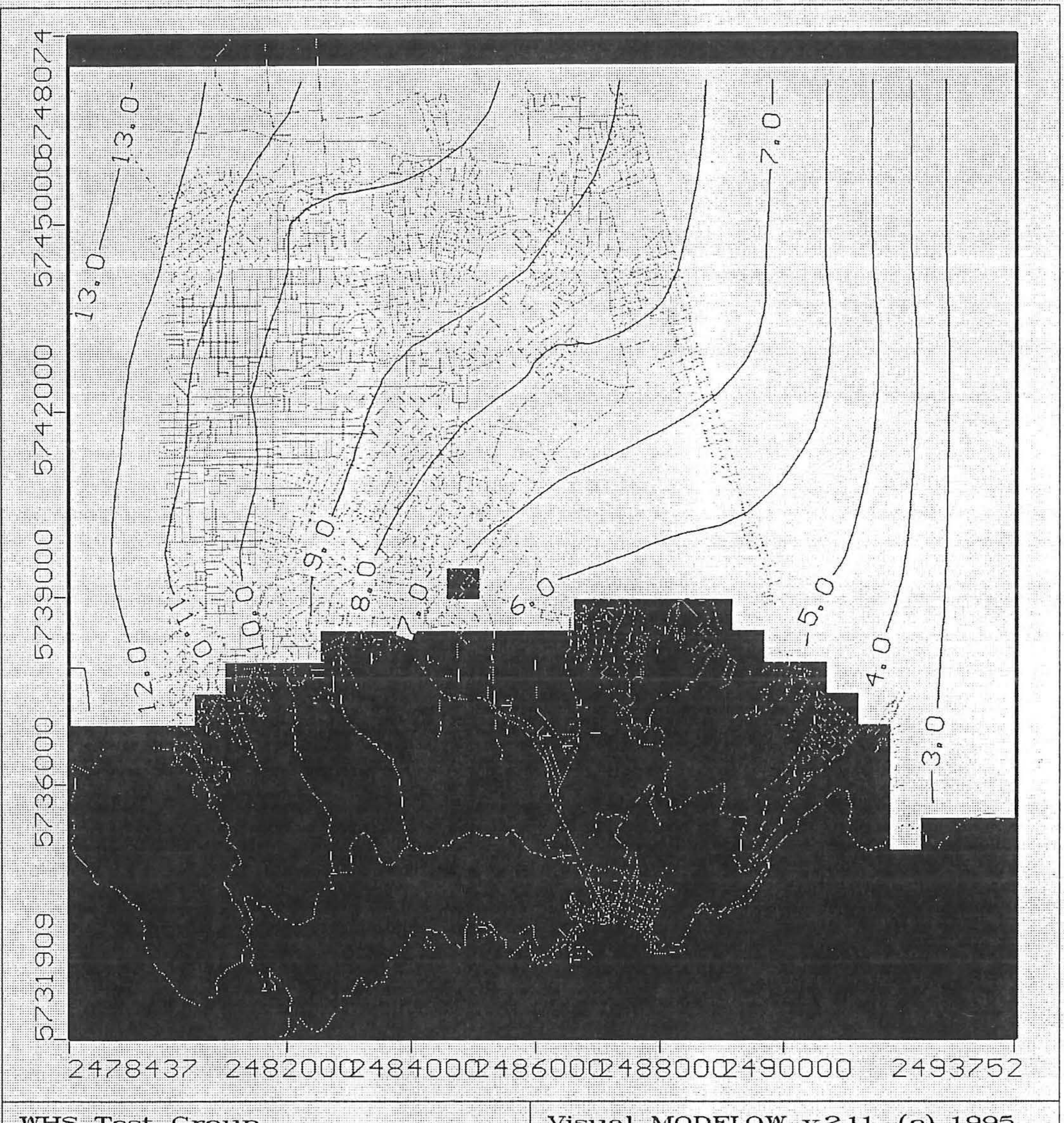
Mean error: 0.1804132 Mean abs. err: 0.7189214 RMS error: 0.9222991

WHS Test Group 6 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 1

*Note: These are the observation wells in the Heathcote area

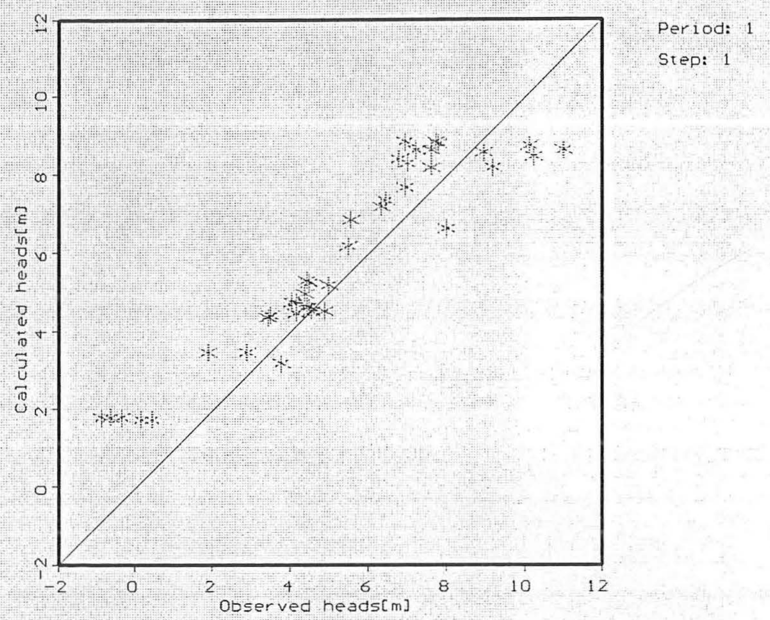
Simulated hydraulic heads after abstractions ceased from the wells M36/1163, M36/1072, M36/1187, M36/1013, M36/2202, M36/1004, M36/1014, M36/1045, M36/1045, M36/2244.





WHS Test Group
6 May 98

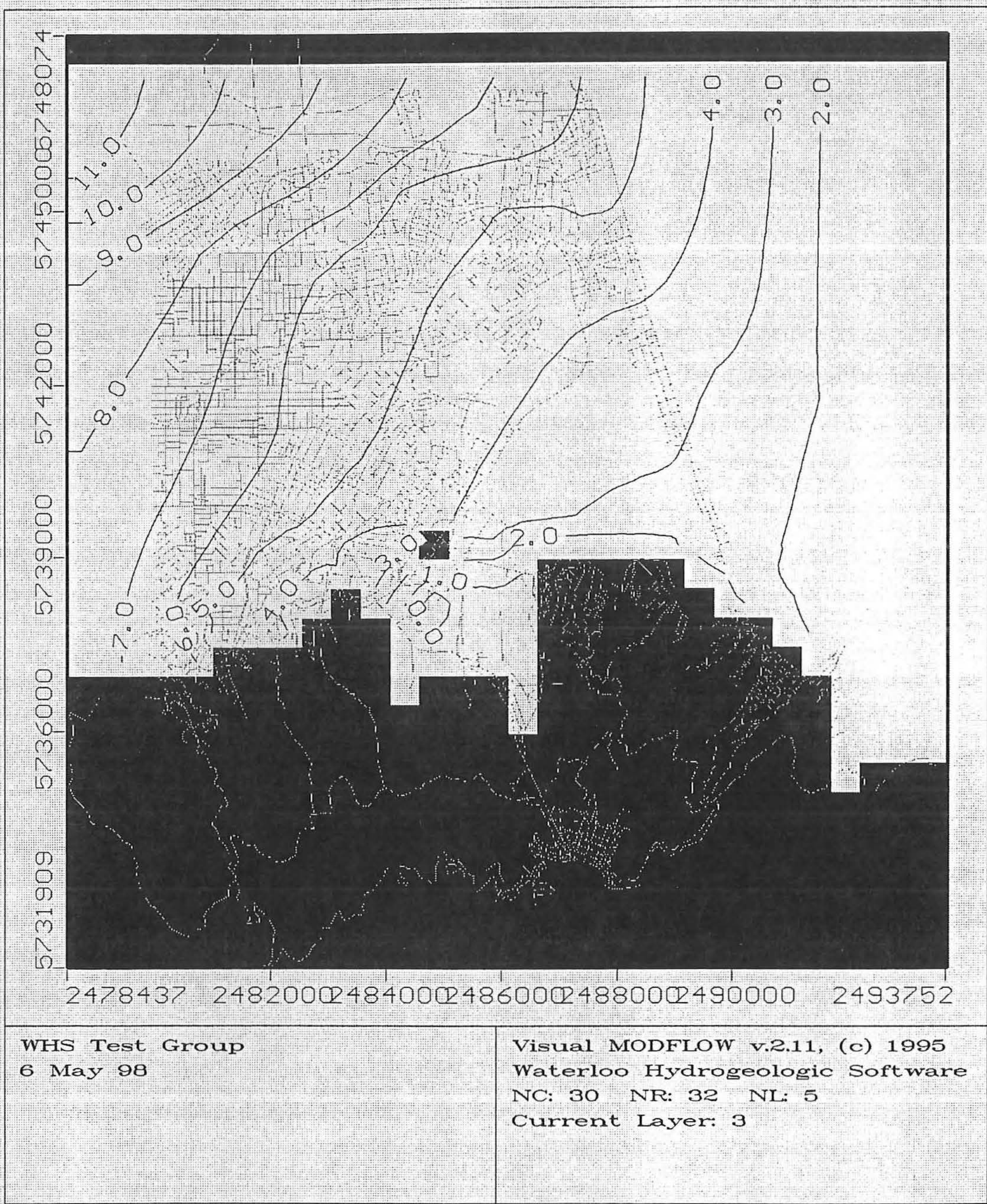
Visual MODFLOW v.2.11, (c) 1995
Waterloo Hydrogeologic Software
NC: 30 NR: 32 NL: 5
Current Layer: 5

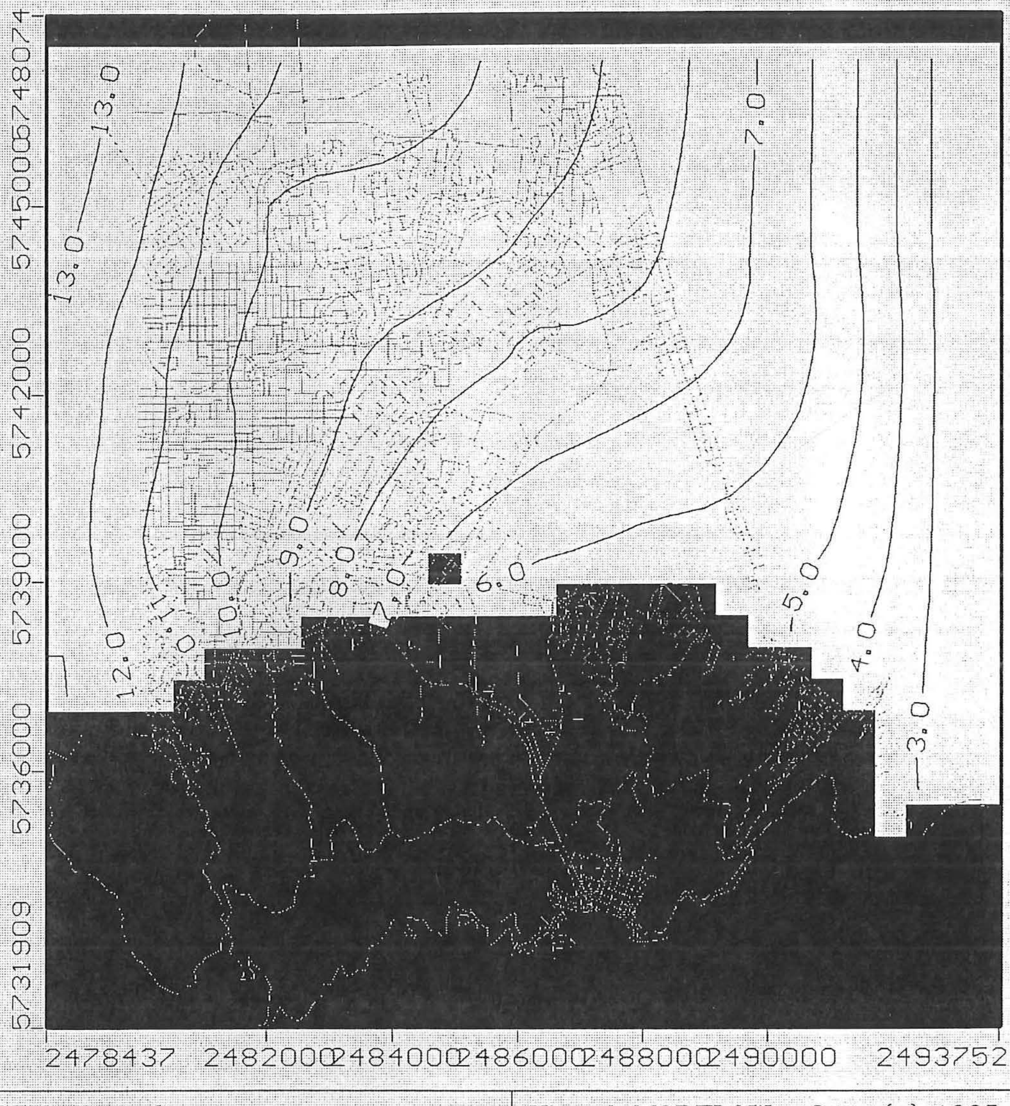


Mean error: 0.5668237 Mean abs. err: 1.03636 RMS error: 1.21633

WHS Test Group 6 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 1

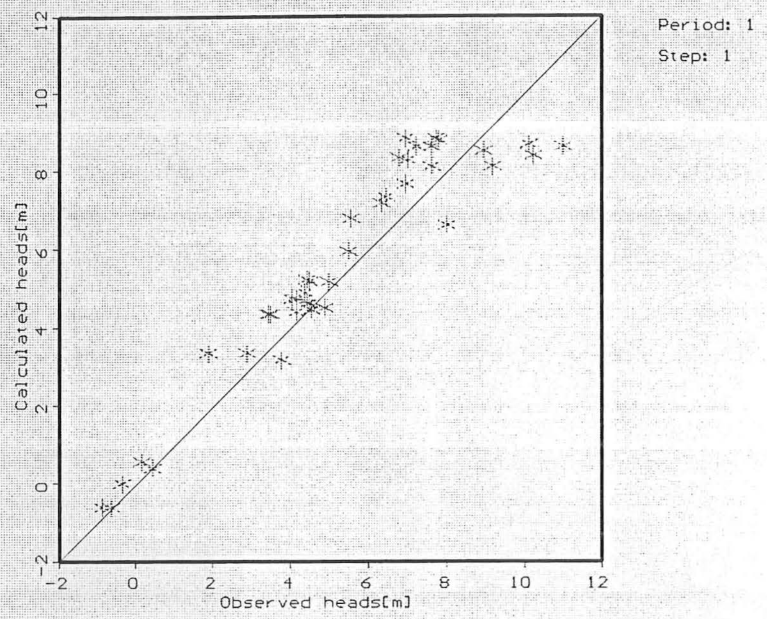
Simulated hydraulic heads after abstractions ceased from the wells M36/1187, M36/1013, M36/2202, M36/1004, M36/1014, M36/1045, and M36/2244.





WHS Test Group
6 May 98

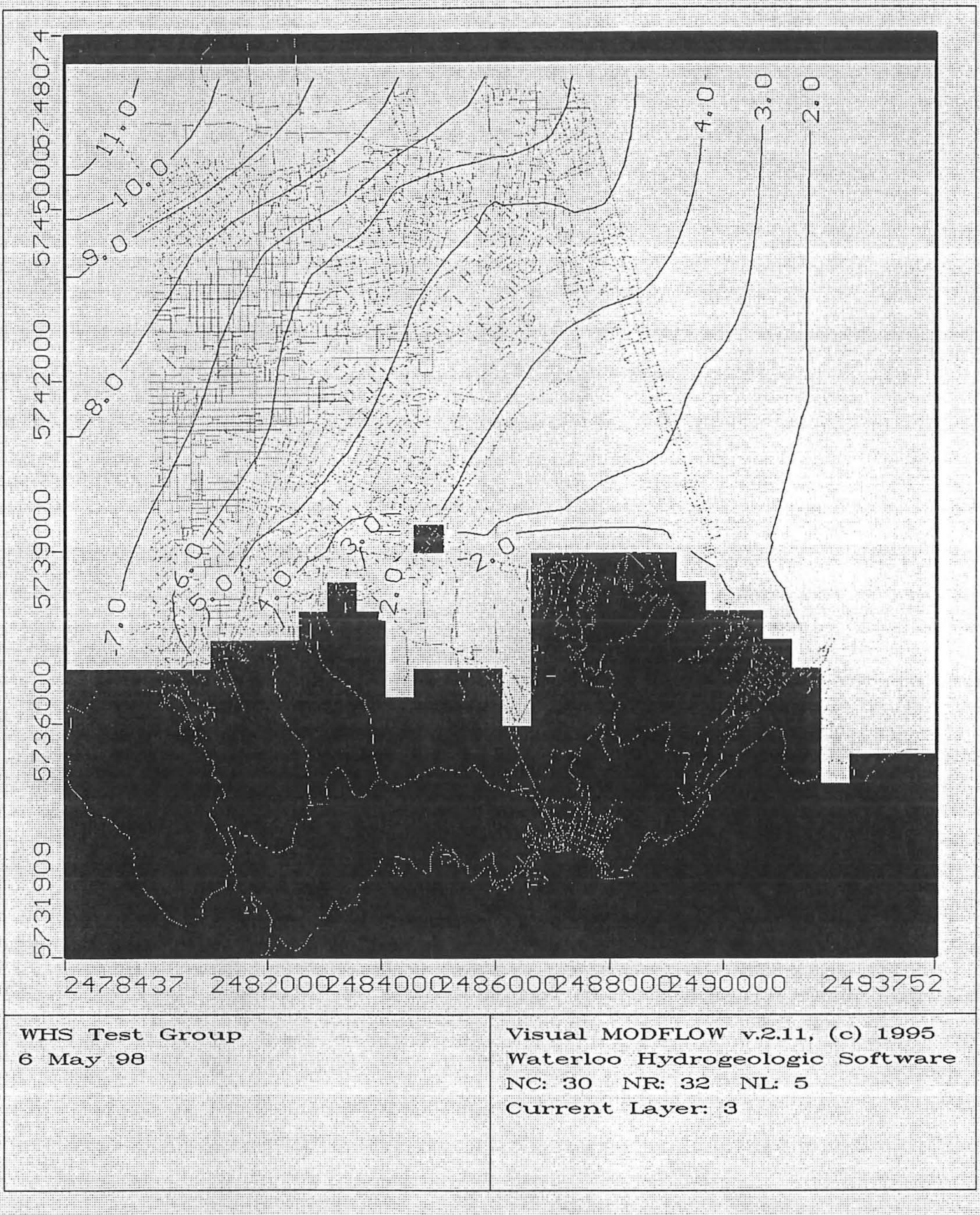
Visual MODFLOW v.2.11, (c) 1995
Waterloo Hydrogeologic Software
NC: 30 NR: 32 NL: 5
Current Layer: 5

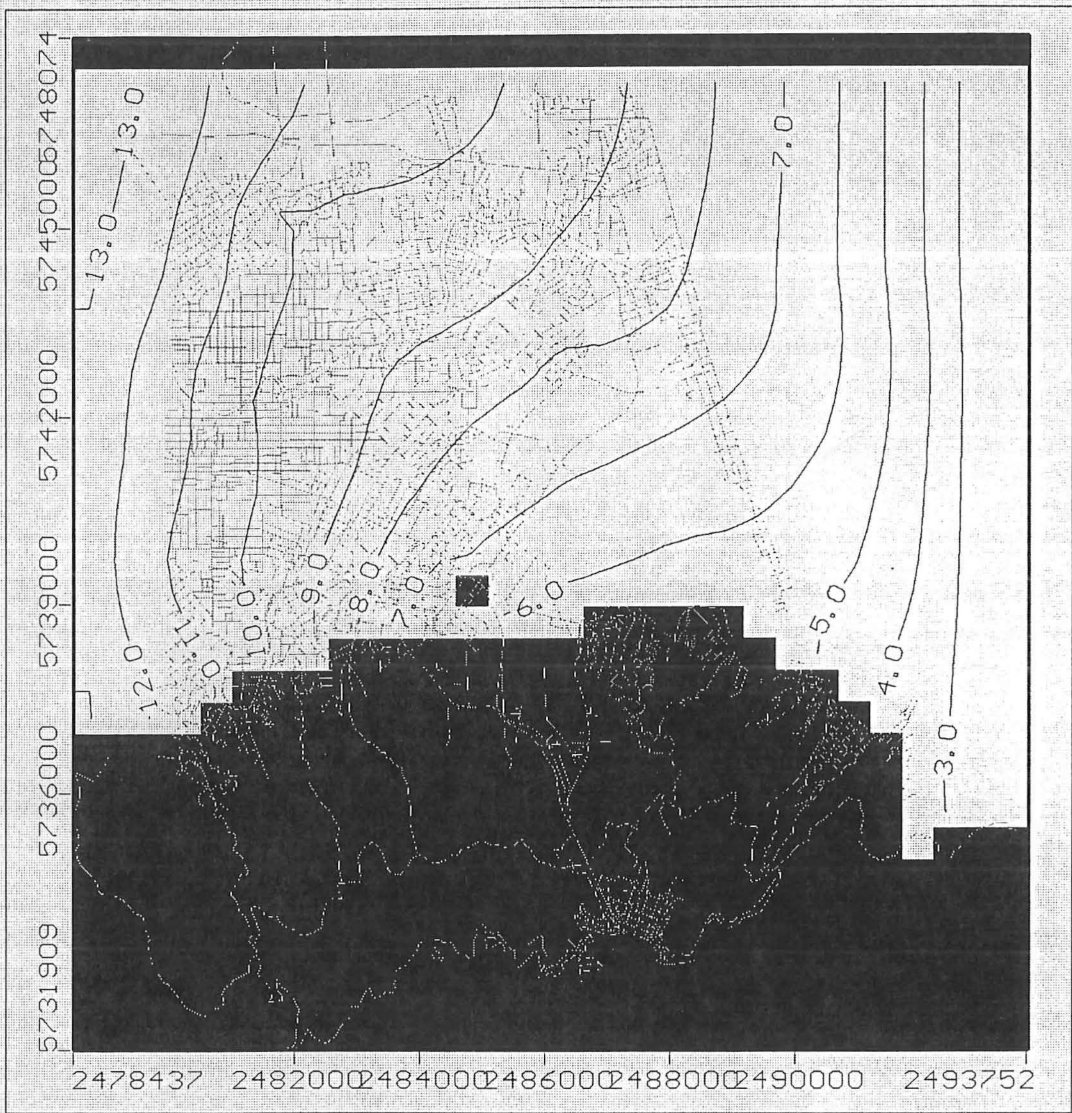


Mean error: 0.3143423 Mean abs. err: 0.7930685 RMS error: 0.9682594

WHS Test Group 6 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 5

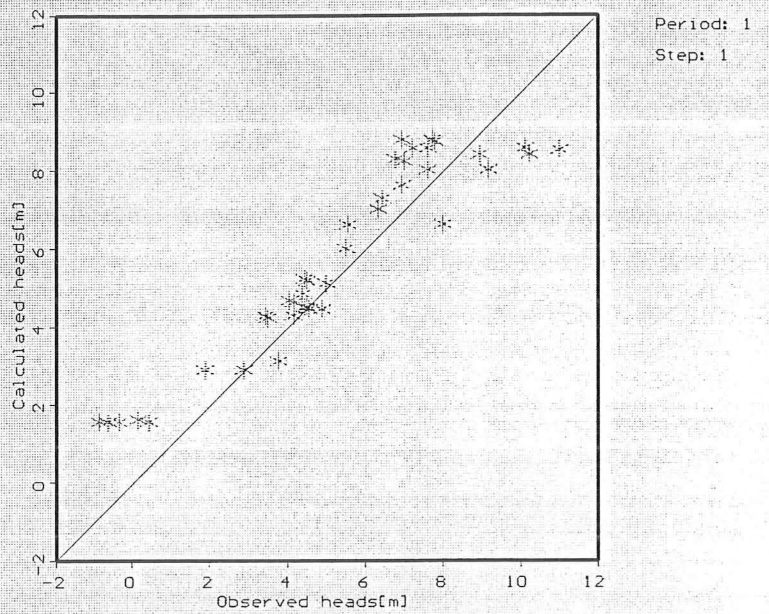
Simulated hydraulic heads after abstractions ceased from the wells M36/1163 and M36/1072.





WHS Test Group
6 May 98

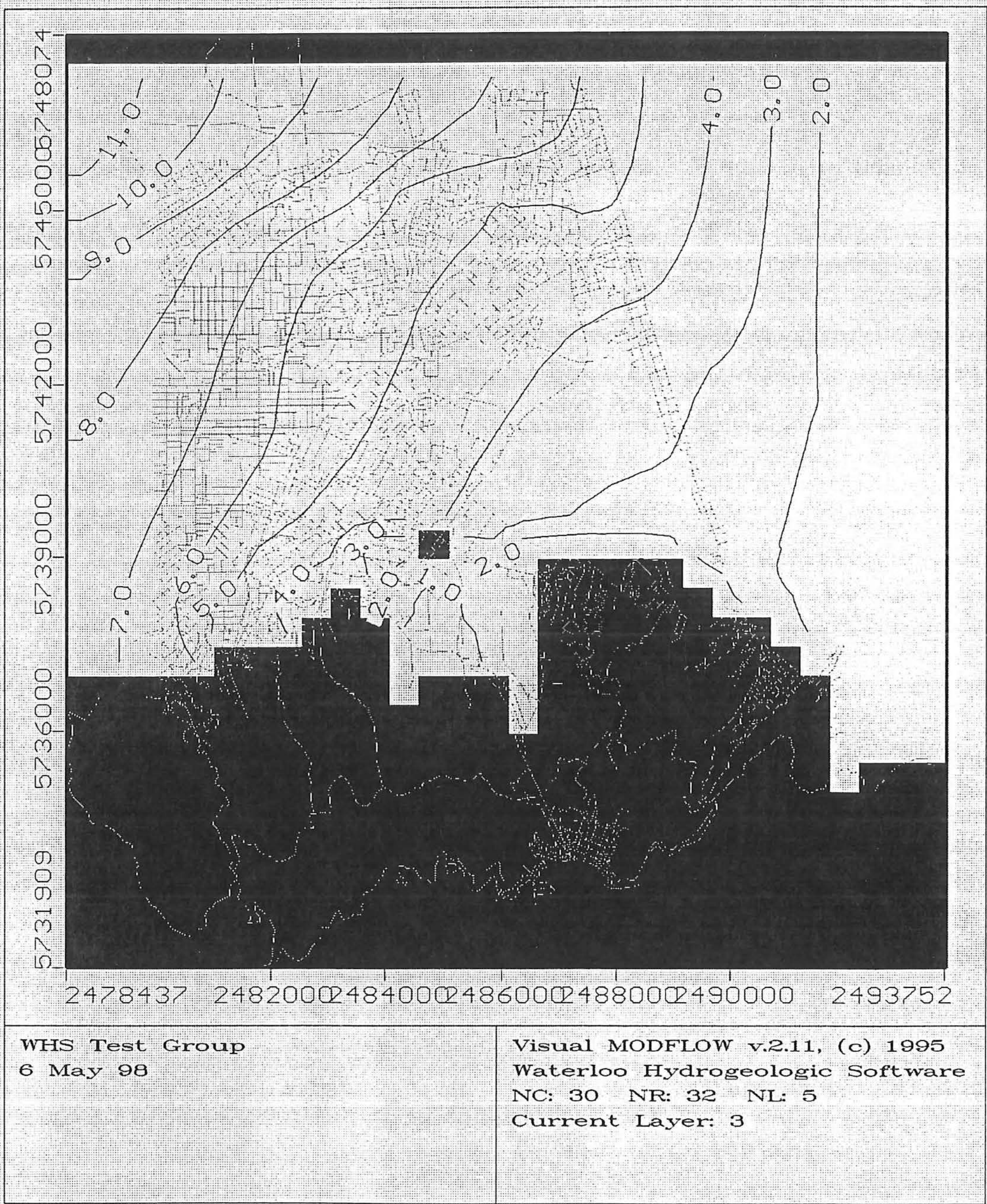
Visual MODFLOW v.2.11, (c) 1995
Waterloo Hydrogeologic Software
NC: 30 NR: 32 NL: 5
Current Layer: 5

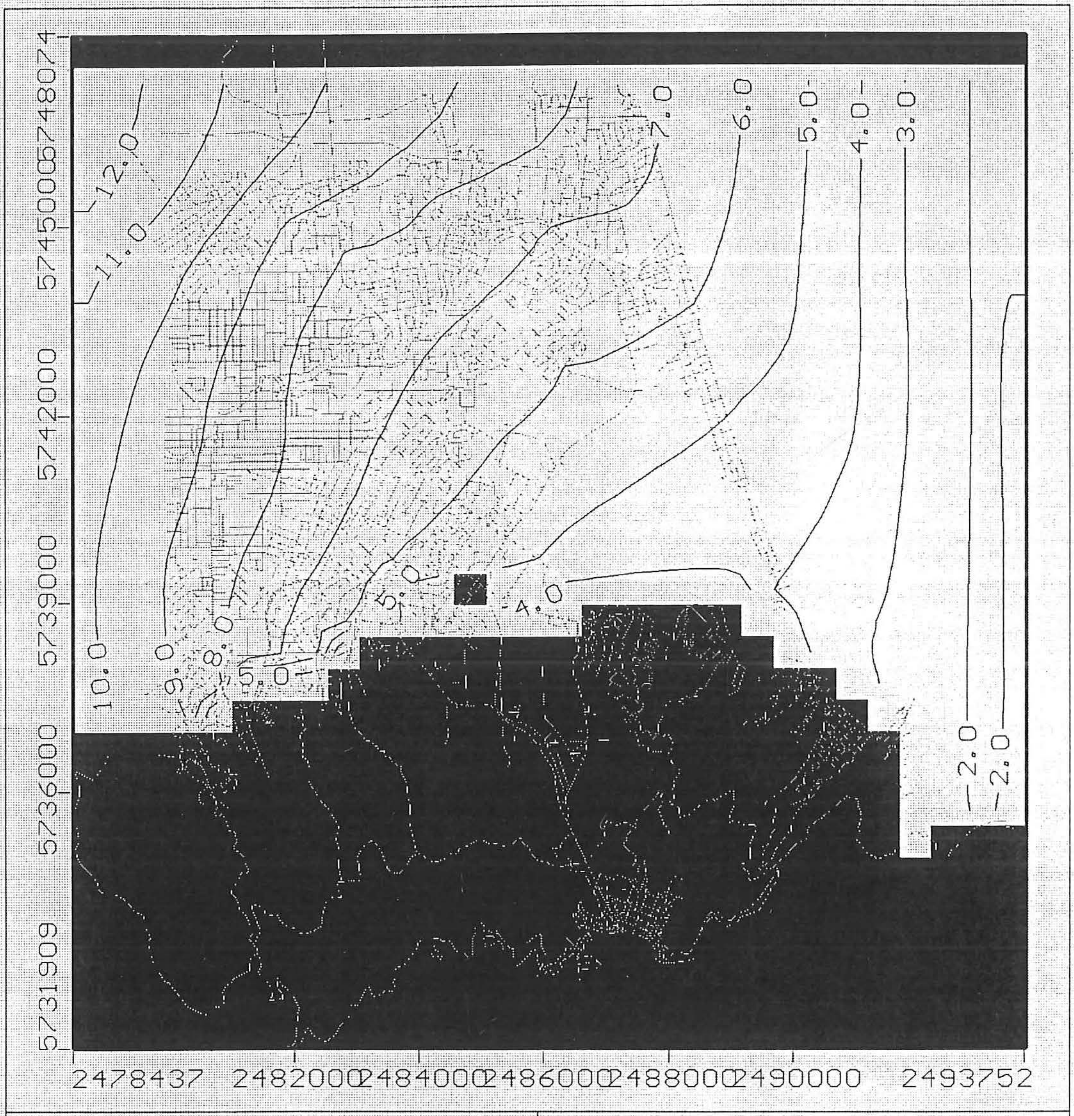


Mean error: 0.4329011 Mean abs. err: 0.9397698 RMS error: 1.13974

WHS Test Group 6 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 5

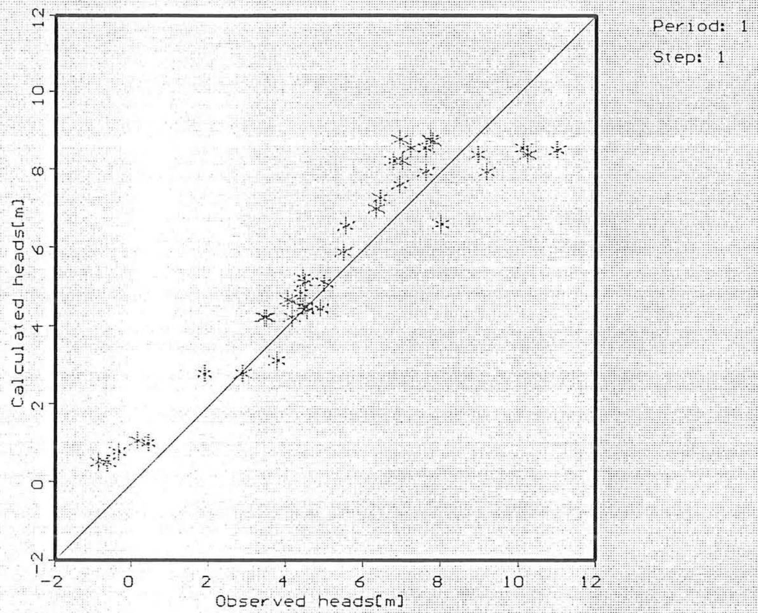
Simulated hydraulic heads after abstractions ceased from the well M36/1163.





WHS Test Group
6 May 98

Visual MODFLOW v.2.11, (c) 1995
Waterloo Hydrogeologic Software
NC: 30 NR: 32 NL: 5
Current Layer: 4

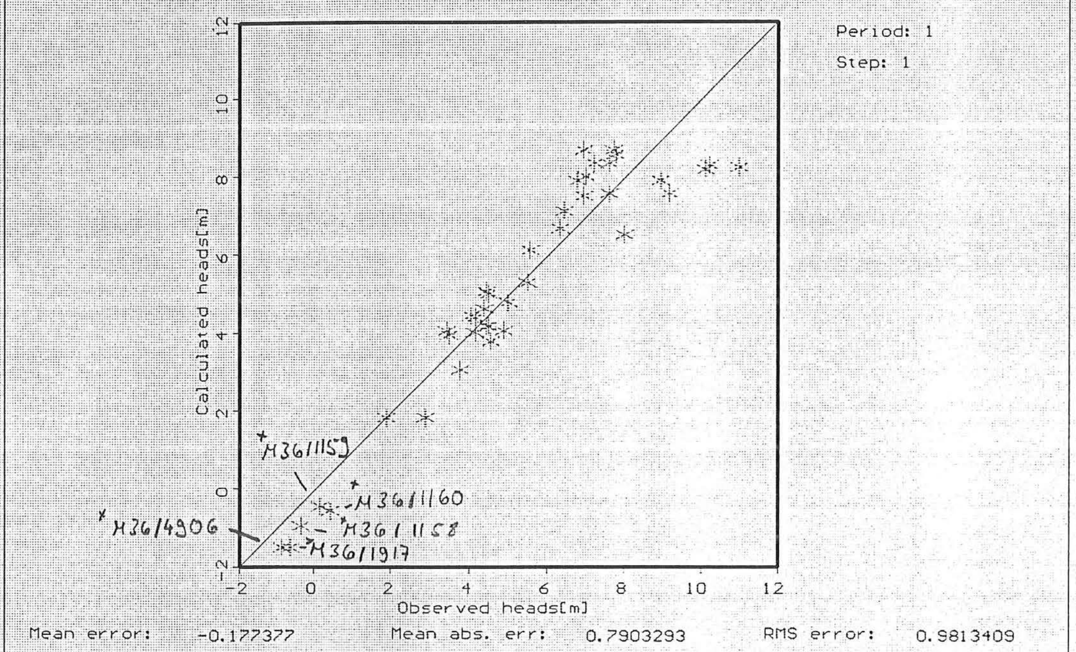


Mean error: 0.3192341 Mean abs. err: 0.8324006 RMS error: 0.9949746

WHS Test Group 6 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 1

Appendix F.5 Sensitivity analysis for the Heathcote area.

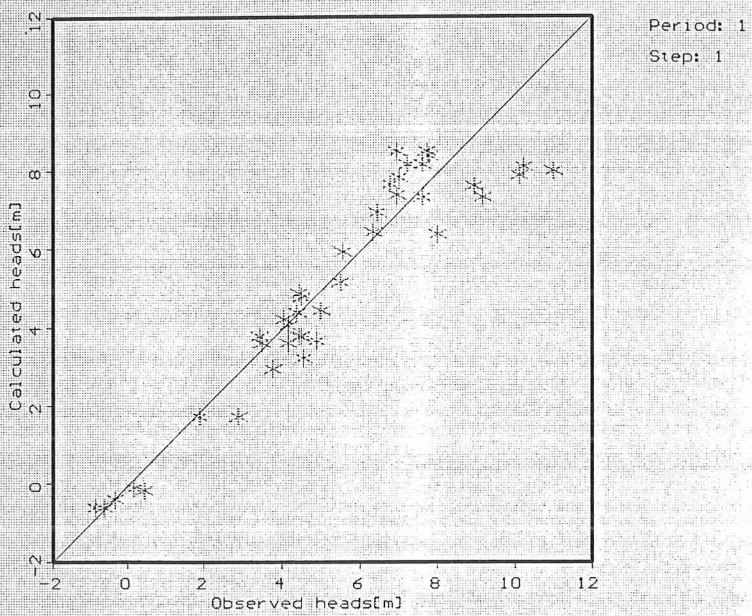
Hydraulic conductivity of Aquitard 1 times 0.5.



WHS Test Group 25 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 2

x Note: These are the observation wells in the Heathcote area, which should be focussed on.

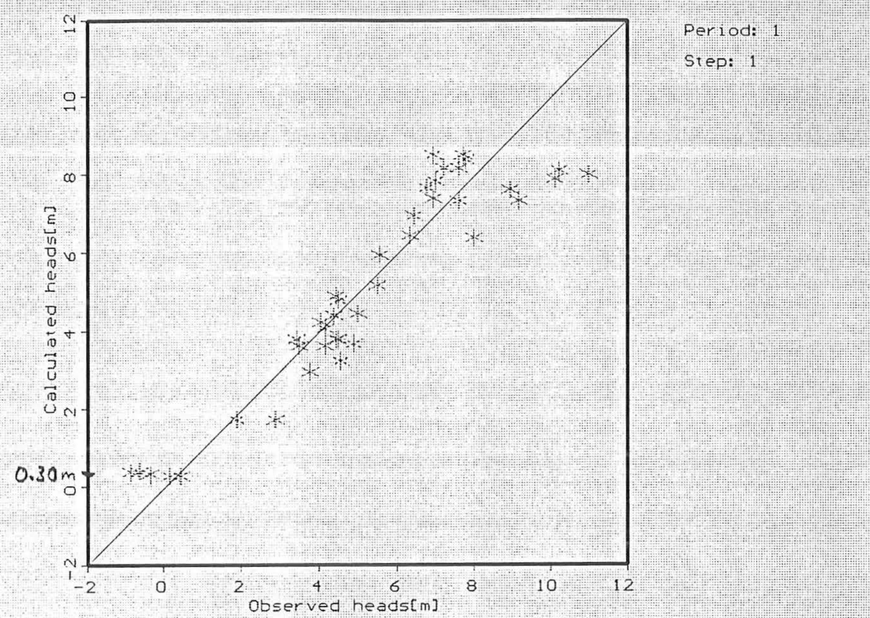
Recalibration of wells in the Heathcote area by altering Aquifer 1 hydraulic conductivity in the Heathcote area.



Mean error: -0.2991427 Mean abs. err: 0.7490528 RMS error: 1.00849

WHS Test Group 25 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 1

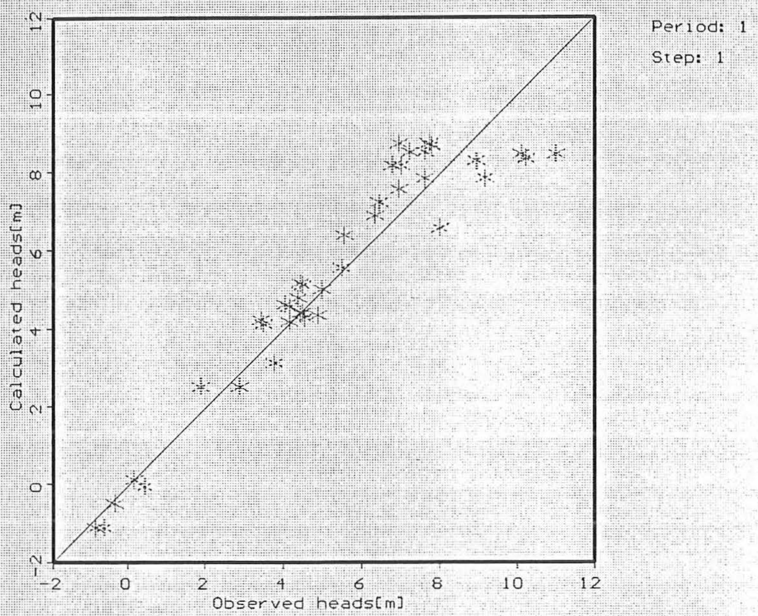
Finally ceasing pumping from the wells M36/1163 and M36/1072 in the Heathcote area.



Mean error: -0.2129442 Mean abs. err: 0.7962511 RMS error: 1.03648

WHS Test Group 25 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 1

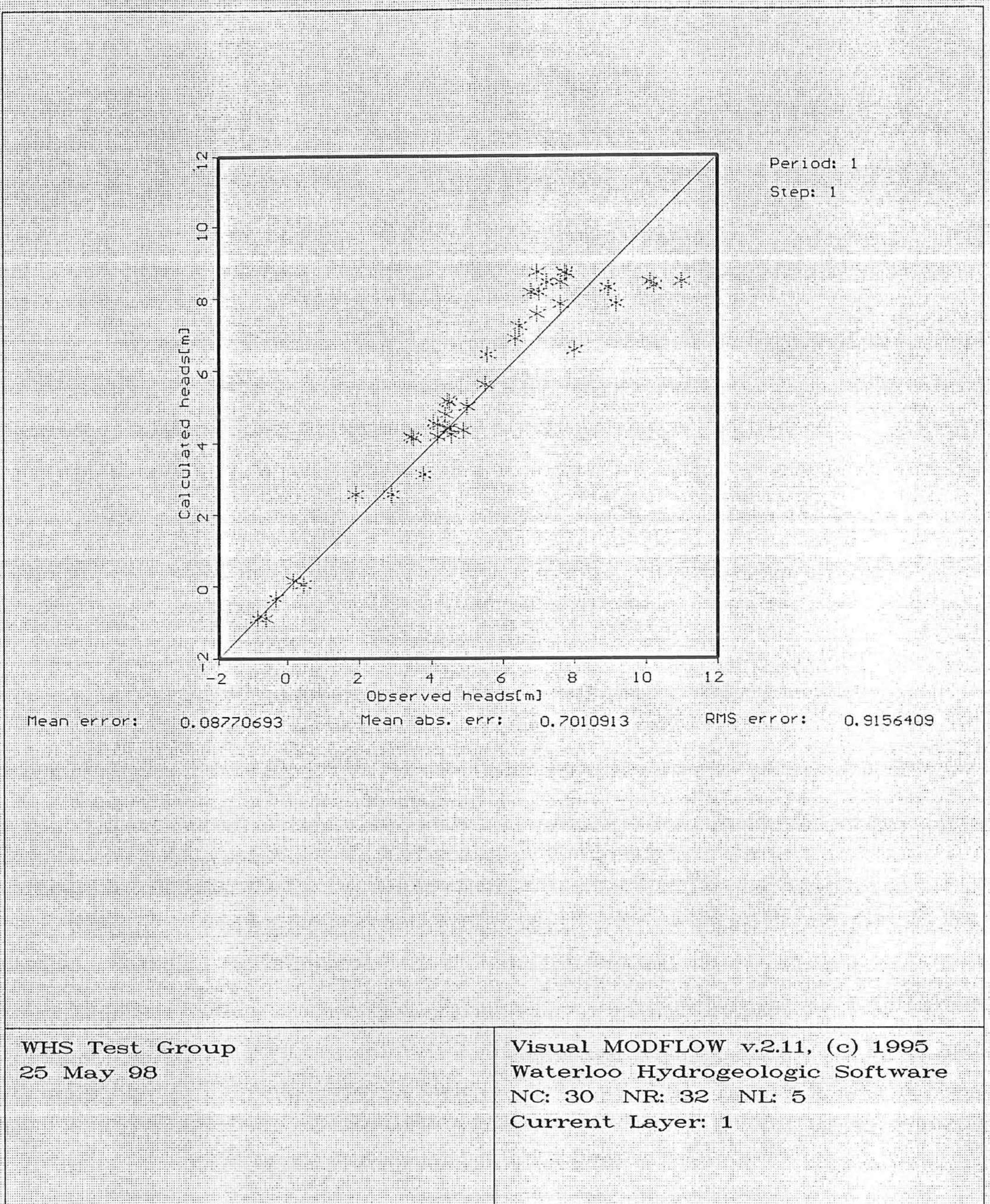
Hydraulic conductivity Aquitard 1 times 2.



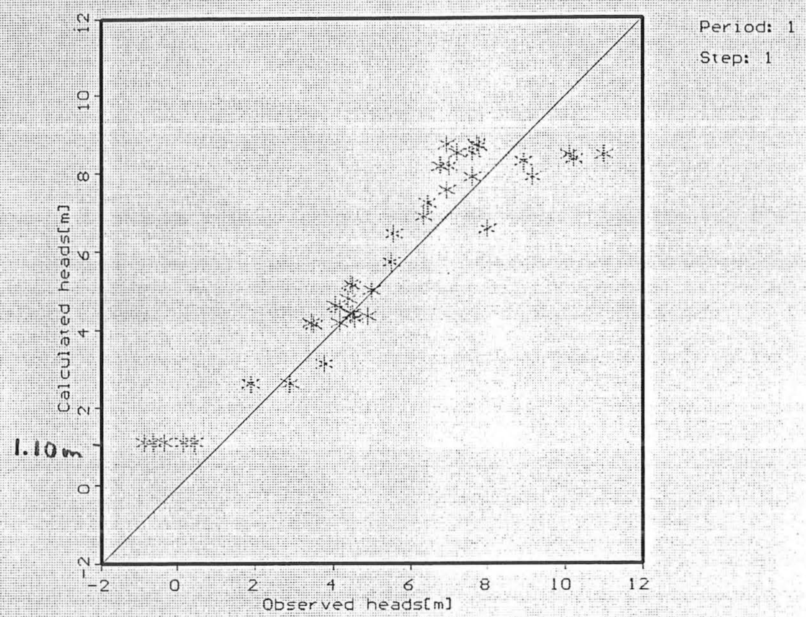
Mean error: 0.07751549 Mean abs. err: 0.7184364 RMS error: 0.921147

WHS Test Group 25 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 1

Recalibration of wells in the Heathcote area by altering Aquifer 1 hydraulic conductivity in the Heathcote area.



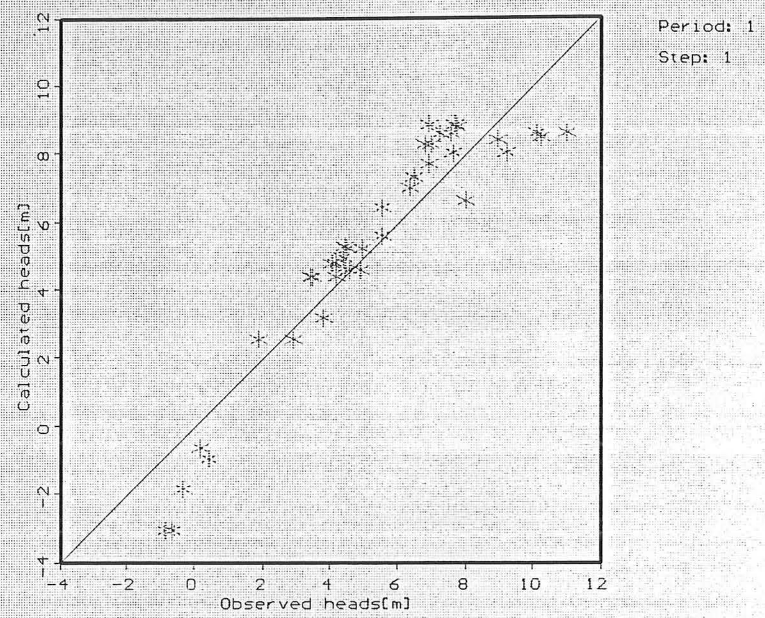
Finally ceasing pumping from the wells M36/1163 and M36/1072 in the Heathcote Valley area.



Mean error: 0.2922299 Mean abs. err: 0.8565033 RMS error: 1.04445

WHS Test Group 25 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 1

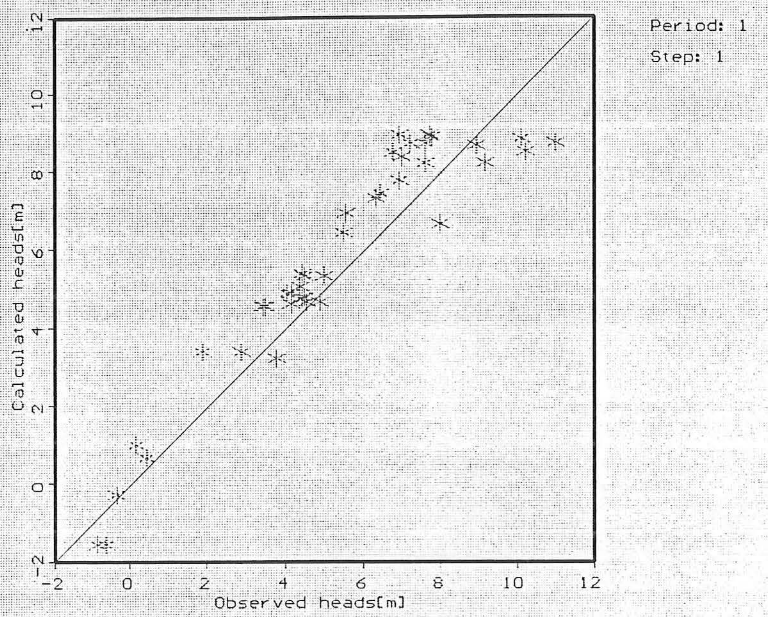
Hydraulic conductivity of Aquifer 1 times 0.5.



Mean error: 0.01779976 Mean abs. err: 0.9299947 RMS error: 1.12431

WHS Test Group 25 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 1

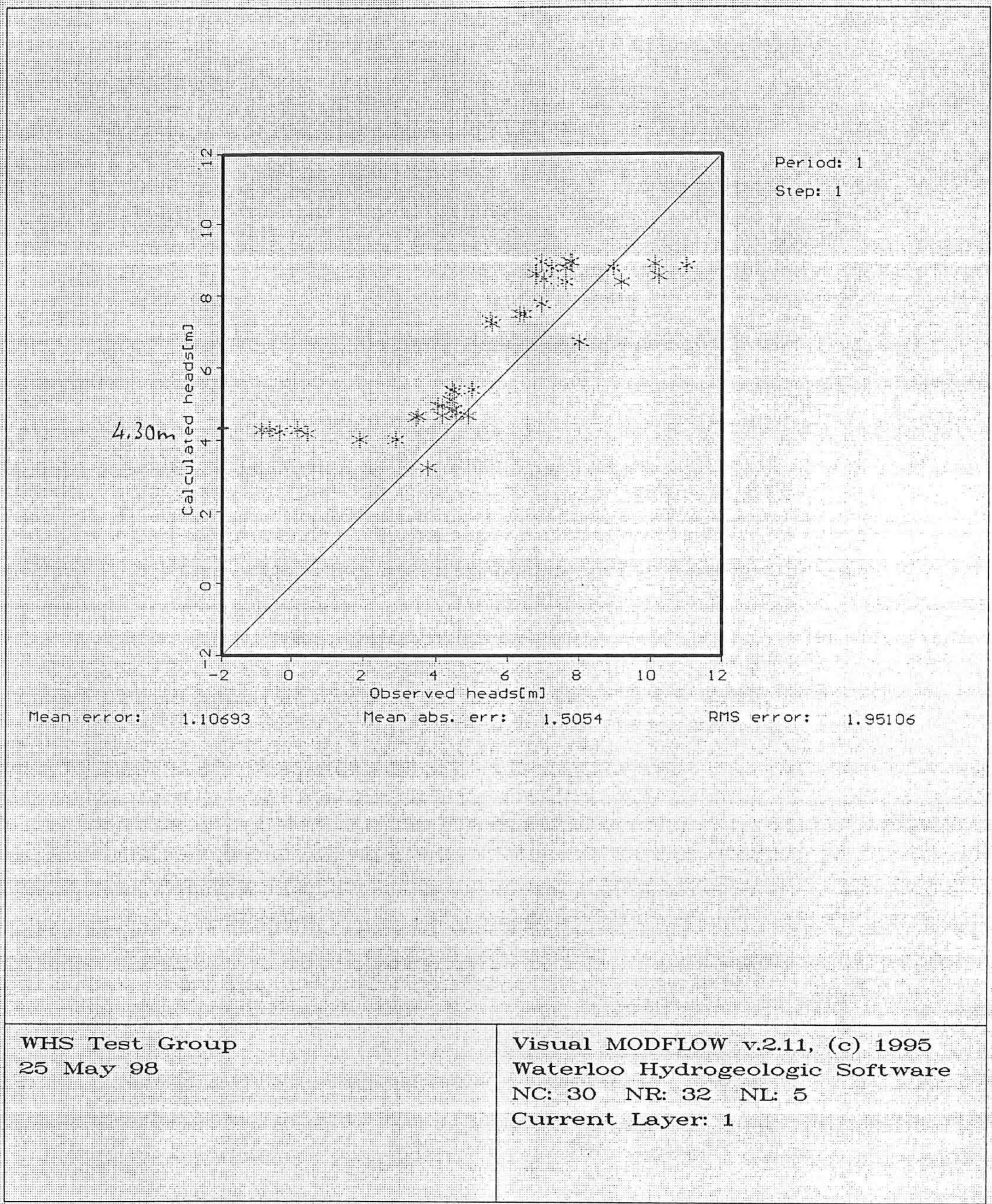
Recalibration of wells in the Heathcote area by altering Aquitard 1 hydraulic conductivity in the Heathcote area.



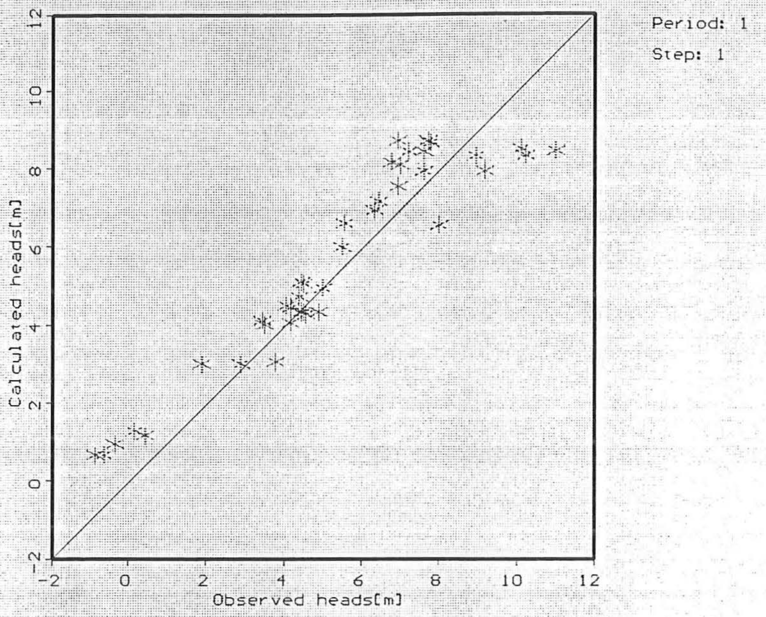
Mean error: 0.4206607 Mean abs. err: 0.9237072 RMS error: 1.05452

WHS Test Group 25 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 1

Finally ceasing pumping from the wells M36/1163 and M36/1072 in the Heathcote area.



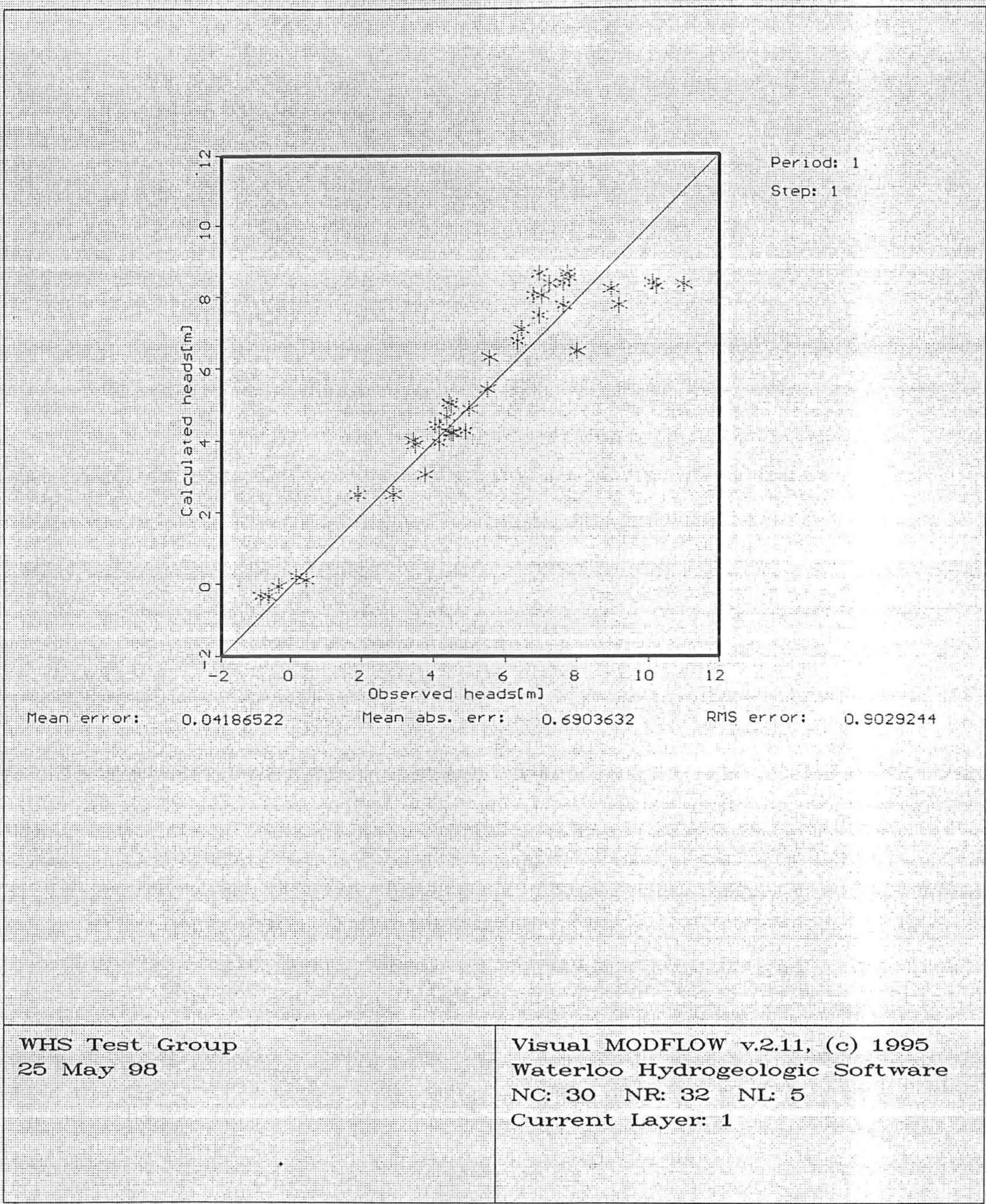
Hydraulic conductivity of Aquifer 1 times 2.



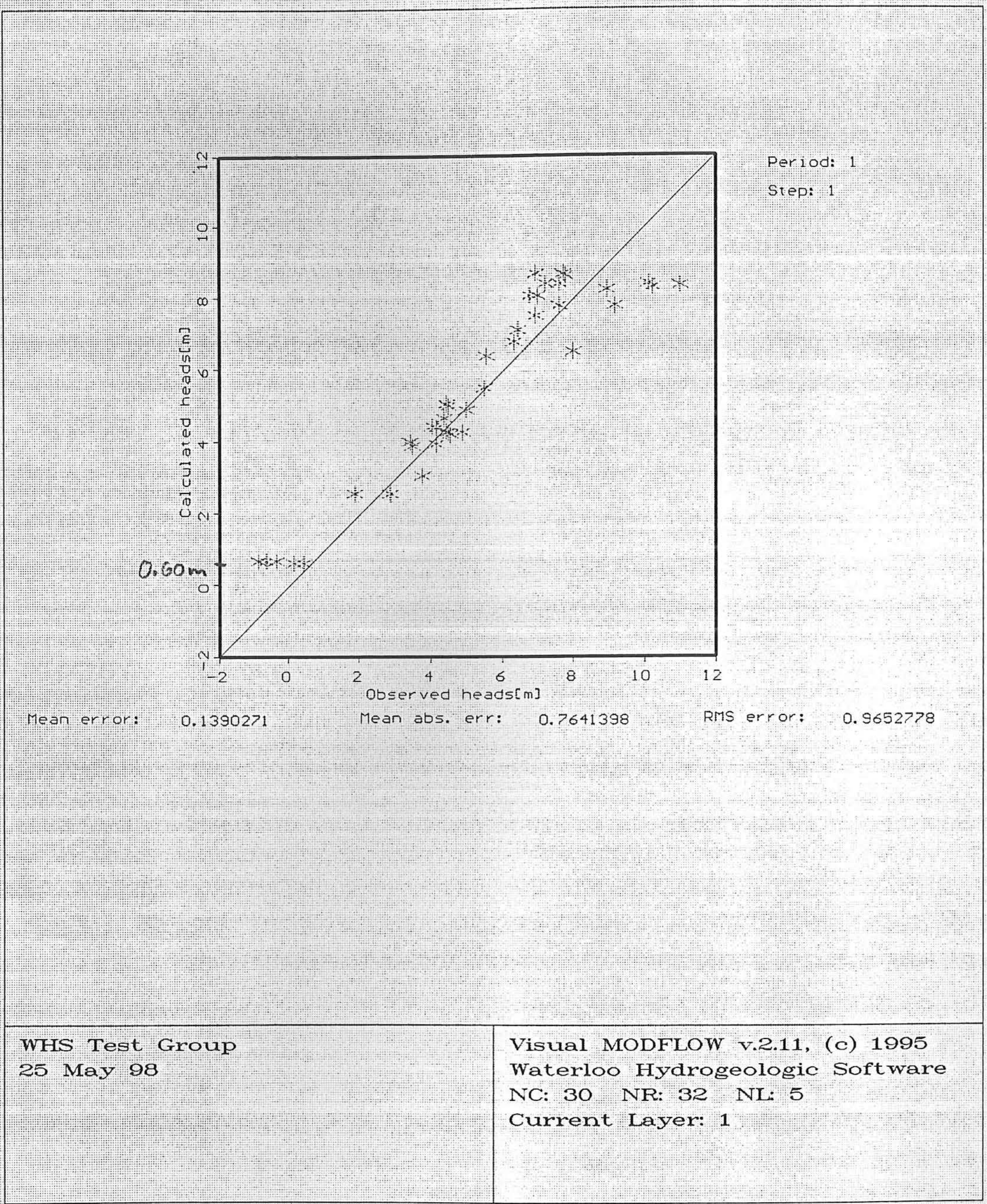
Mean error: 0.2859111 Mean abs. err: 0.8431356 RMS error: 1.01131

WHS Test Group 25 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 1

Recalibration of wells in the Heathcote area by altering Aquitard 1 hydraulic conductivity in the Heathcote area.

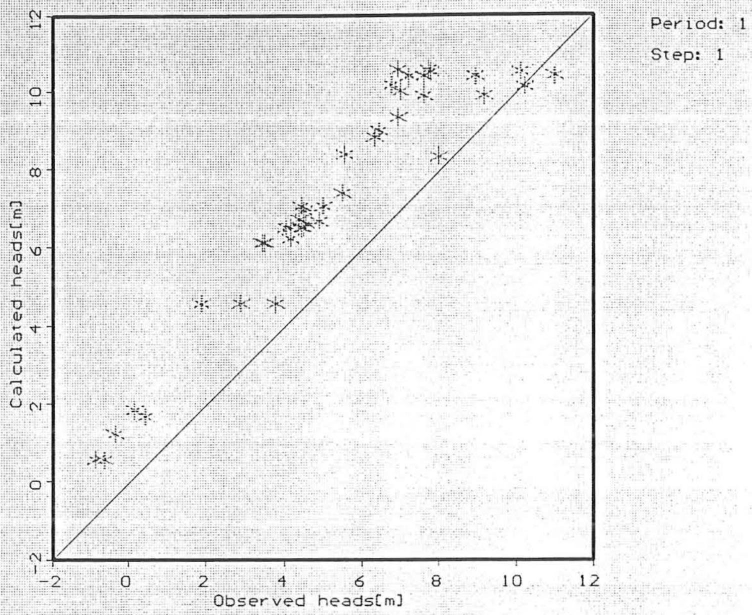


Finally ceasing pumping from the wells M36/1163 and M36/1072 in the Heathcote area.



Appendix F.6 Sensitivity analysis.

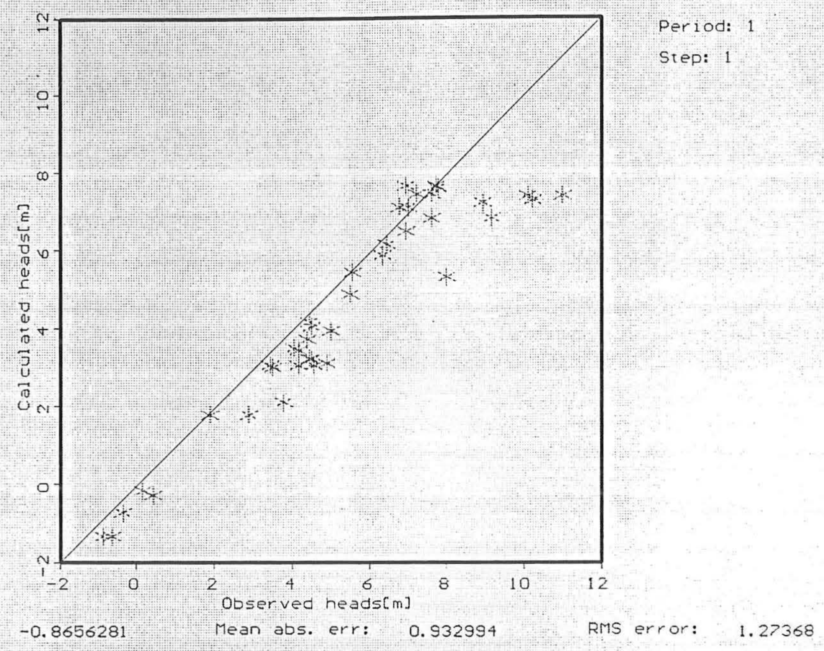
Aquitard 1 hydraulic conductivity times 0.5.



Mean error: 1.99522 Mean abs. err: 2.03154 RMS error: 2.19984

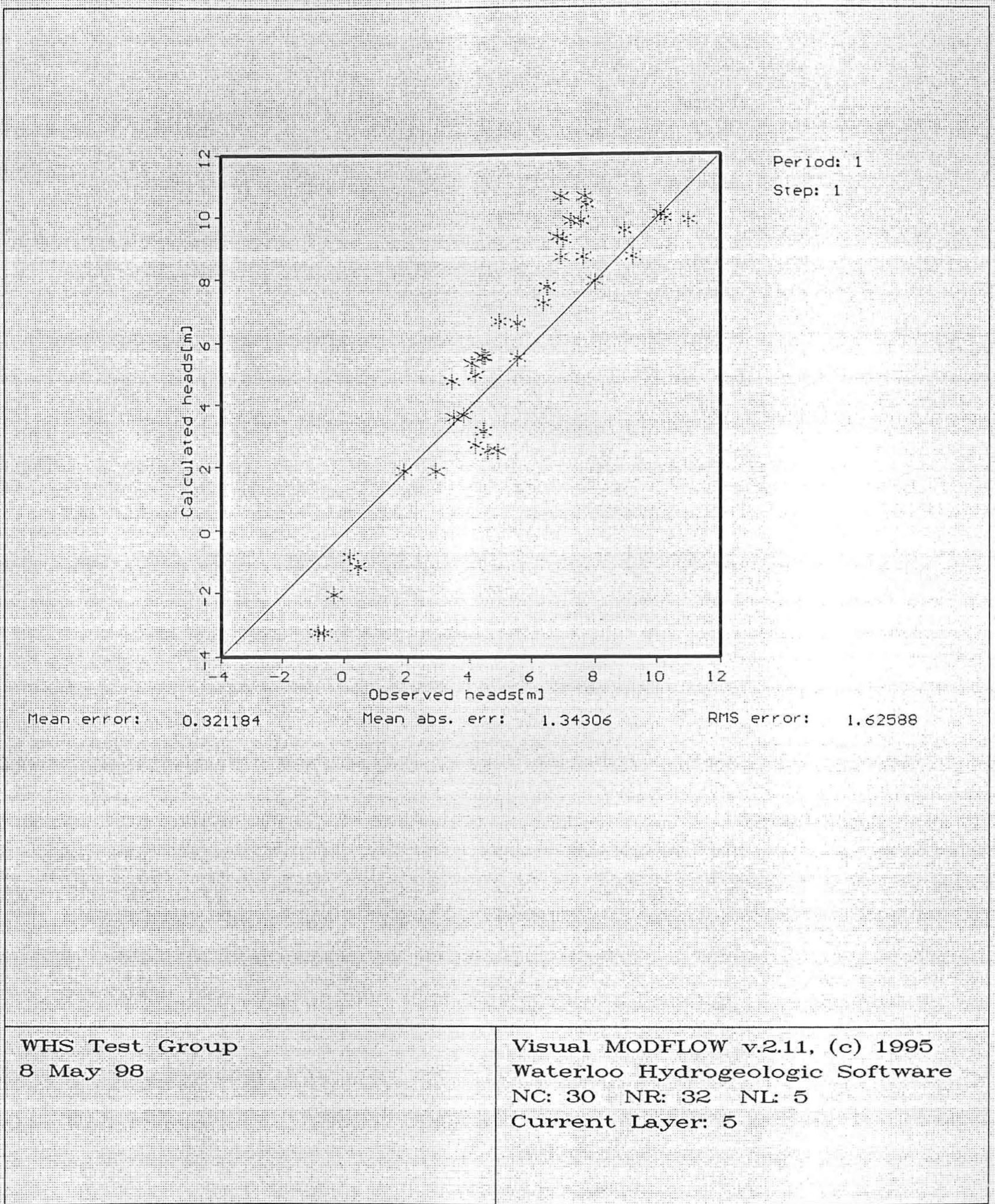
WHS Test Group 8 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 1

Aquitard 1 hydraulic conductivity times 2.

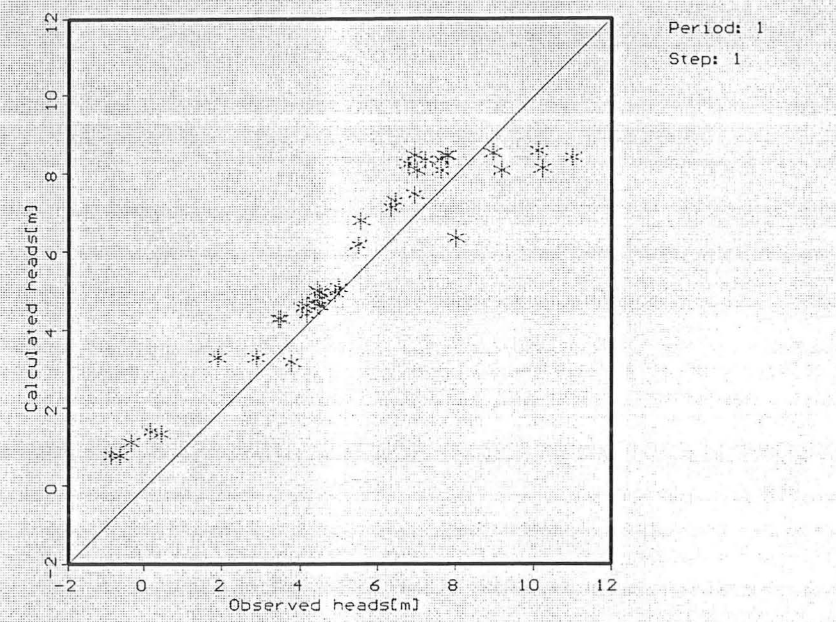


WHS Test Group 8 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 1

Aquifer 1 hydraulic conductivity times 0.5.



Aquifer 1 hydraulic conductivity times 2.



Mean error: 0.3722652 Mean abs. err: 0.8705928 RMS error: 1.04324

WHS Test Group 11 May 98	Visual MODFLOW v.2.11, (c) 1995 Waterloo Hydrogeologic Software NC: 30 NR: 32 NL: 5 Current Layer: 3